EFFECTS OF THE CABINET GORGE KOKANEE HATCHERY ON WINTERING BALD EAGLES IN THE LOWER CLARK FORK RIVER AND LAKE PEND OREILLE, IDAHO

Final Report 1986

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ABSTRACT

Effects of the Cabinet Gorge Kokanee Hatchery on wintering bald eagles in the lower Clark Fork River and Lake Pend Oreille, Idaho

The abundance and distribution of bald eagles (*Haliaeetus leucocephalus*) on the lower Clark Fork River, Lake Pend Oreille, and the upper Pend Oreille River, Idaho, were documented during the winters of 1985-86 and 1986-87. Peak counts of bald eagles in weekly aerial censuses were higher in 1985-86 (274) and 1986-87 (429) than previously recorded in mid-winter surveys. Differences in eagle distribution within and between years were apparently responses to changes in prey availability.

Eight bald eagles were captured and equipped with radio transmitters in the winter and spring of 1986. Residencies within the study area averaged 13.9 days in 1985-86 and 58.3 days for the four eagles that returned in 1986-87. The eagles exhibited considerable daily movement throughout the study area. After departing the area, one eagle was later sighted approximately 1,185 km to the southwest in northern California.

Three major communal roosts used by bald eagles were identified. Two roosts were located on federally-owned land: one was on a privately-owned island. Eagles roosted in Douglas-fir (*Pseudotsusa menzeisii*), western larch (*Larix occidentalis*), and black cottonwood (*Populus trichocaroa*) that averaged 63.1 cm diameter at breast height and 33.5 m height. Each site was relatively secure from human disturbance during its period of use.

The most common habitat types along the shoreline and upland areas adjacent to Lake Pend Oreille were western redcedar (*Thuia plicata*)/queencup beadlily (*Clintonia uniflora*) and Douglas-fir/ninebark (*Physocarpus malvaceus*). Greater than 50% of the area was forested: in the upper canopy, mean tree height exceeded 22 m and mean density exceeded 3 trees/ha. Land ownership adjacent to the lake was predominately private in the north and federal in the south.

Eagle behavioral activity was recorded at time budget sessions at areas of heavy use. Perching in live trees was the most common behavior observed; ponderosa pine (*Pinus ponderosa*), Douglas-fir, and black cottonwood were preferred

tree species. Overall capture success rate of fish was greater than 85%: aerial capture was most successful (78%).

Remains of birds found in regurgitated pellets of bald eagles (N = 208) were followed in numbers by remains of fish (N = 175) and mammals (N = 21). Prey remains collected under diurnal feeding perches consisted mostly of fish, primarily Lake Superior whitefish (Coresonas clupeaformis) and (kokanee salmon [Onchorhynchus nerka).

Recoveries of tagged salmon carcasses placed in the Clark Fork River below Cabinet Gorge Dam indicated mid-channel releases were most effective in making carcasses accessible to foraging eagles.

INTRODUCTION

BACKGROUND

The bald eagle (Haliaeetus leucocephalus) has received "Endangered" species status by the U.S. Department of Interior in 43 of the lower 48 contiguous states and is listed as "Threatened" in the other five states (U.S. Fish and Wildlife Service 1984). The designation of the species as "Endangered" in Idaho has required state and federal agencies to protect important bald eagle habitat.

Lake Pend Oreille, in northern Idaho, has hosted a population of wintering bald eagles which is drawn to the area by an abundance of fish residing in the lake, by waterfowl migrating south from Canada, and by the presence of open water conditions during winter. The availability of kokanee salmon (Onchorhvnchus nerka) which spawn in the lake and its tributaries from November to January has been linked to the presence of wintering bald eagles in the area (Myer 1979). Kokanee salmon were inadvertently introduced into the Clark Fork River system from Flathead Lake as a result of a flood event in the mid-1930's. By the 1940's and 1950's Lake Pend Oreille had developed into a major sport and commercial fishery with more than one million salmon harvested annually from 1950-65.

Even though the fishery was highly productive during this period, several factors began to influence its stability. The dewatering of salmon redds by lower lake levels as a result of water releases at Albeni Falls Dam downstream on the Pend Oreille River contributed to a decline in annual recruitment in the population. In addition, major spawning runs of salmon that migrated upstream in the Clark Fork River were blocked by the construction of Cabinet Gorge Dam, thus eliminating approximately 90% of the spawning area in the system. The complexity and severity of the salmon's population status increased still further with the establishment of non-native oppossum shrimp (Mysis relicta) which compete with young kokanee salmon for zooplankton (Larry LaBolle, personal communication, 1987).

In the 1960's, the first measure was taken to ameliorate these effects when the operation of the Albeni Falls Dam was modified by establishing low pool on the lake prior to salmon spawning to minimize associated losses. In 1973, the commercial salmon fishery on the lake was eliminated. In 1976, hatchery releases of salmon by the IDFG were begun and the population began to stabilize (6-8 million salmon), but total rehabilitation of the fishery was

prevented due to limited hatchery capacity. In 1986, construction of the Cabinet Gorge Hatchery on the lower Clark Fork River was completed and operation was begun with the task of rebuilding the salmon fishery in the lake which had by then decreased in size to approximately five million fish.

The expected enhancement of the salmon fishery in Lake Pend Oreille will have the potential to add to the significance of the area to wintering bald eagles by providing an abundant, accessible, and dependable food source at a time of increased stress. However, only limited information on the use of the area by wintering bald eagles has existed from which an evaluation could be based. The U.S. Fish and Wildlife Service in their Biological Opinion on the Cabinet Gorge Hatchery project recommended that this study be undertaken to fill the gap in baseline data on bald eagle use.

GOAL

The goal of this study was to obtain baseline data on bald eagles wintering along the lower Clark Fork River and Lake Pend Oreille, Idaho. It was designed to identify important bald eagle habitat that will allow a future assessment to be made of the effects to bald eagles resulting from the enhancement of the kokanee salmon fishery, and to provide information from which management decisions can be based for the protection and enhancement of eagle habitat.

OBJECTIVES

The objectives of the study were to:

1. Determine the seasonal changes in the numbers and distribution of wintering bald eagles.
2. Identify and characterize important bald eagle perching, feeding, and roosting areas.
3. Determine the species of prey used by bald eagles.
4. Determine the daily flight patterns and behavioral . . activities of wintering bald eagles.
5. Develop recommendations for the protection and/or enhancement of bald eagle habitat along the lower Clark Fork River and Lake Pend Oreille.

STUDY AREA

The primary study area is located in the Panhandle region of Idaho and encompasses the lower 50 km of the Clark Fork River, 184 km of shoreline on Lake Pend Oreille, and the upper 12 km of the Pend Oreille River which flows eventually into the Columbia River (Fig. 1). It is situated in a migration corridor between bald eagle summering areas to the north in Canada and wintering areas further to the south in Idaho, Montana, Nevada, Oregon, Utah, and Wyoming. The climate of the area is influenced by Pacific weather systems and is often wet and cold in winter. The mean minimum temperature has averaged -4.1 degrees Celsius and the mean precipitation 10.1 cm at Sandpoint for the period of November through May from 1951-80.

Lake Pend Oreille is a deep (mean depth = 164 m; maximum depth = 351 m), temperate, oligotrophic lake (Bowles et al. 1986). It is the largest lake in Idaho with approximately 184 km of shoreline and lies at 625 m elevation. It is bordered by the Cabinet Mountains to the northeast, the Green Monarch and Coeur d'Alene mountains to the southeast, and the Selkirk Mountains to the northwest. The northern half of the lake is characterized by several islands and numerous bays, some with extensive shallows; the shoreline along the southern half has more rugged terrain that falls sharply into the deeper waters of the lake. Ownership of land adjacent to the lake is primarily private in the north and federal (USFS) in the south. The lake is a popular summer resort area, but human activity there becomes extremely limited in mid-winter. Many northern bays become frozen during colder winters. The level of the lake was lowered by an average of 3.6 m to a mean low pool of 622 m from November to April in 1985-86 and 1986-87 by water released at Albeni Falls Dam.

The Clark Fork River is the major source of water to the area, entering from the east in Montana out of Noxon Rapids Dam and into Cabinet Gorge Reservoir, then through Cabinet Gorge Dam into Lake Pend Oreille. It is bordered by the Cabinet Mountains to the northeast and the Bitterroot Range to the southwest. Slow-moving sections of the river above Cabinet Gorge Dam often become frozen during the winter months. Below the dam where discharge rates during the winter may fluctuate greatly (90-900 cms), the river rarely freezes. A substantial delta that exists throughout the winter at the river's mouth is often partially ice-bound.

The Pend Oreille River from its outlet at the northwest portion of Lake Pend Oreille as it proceeds downstream past Sandpoint remains wide and slow-moving. A higher level of

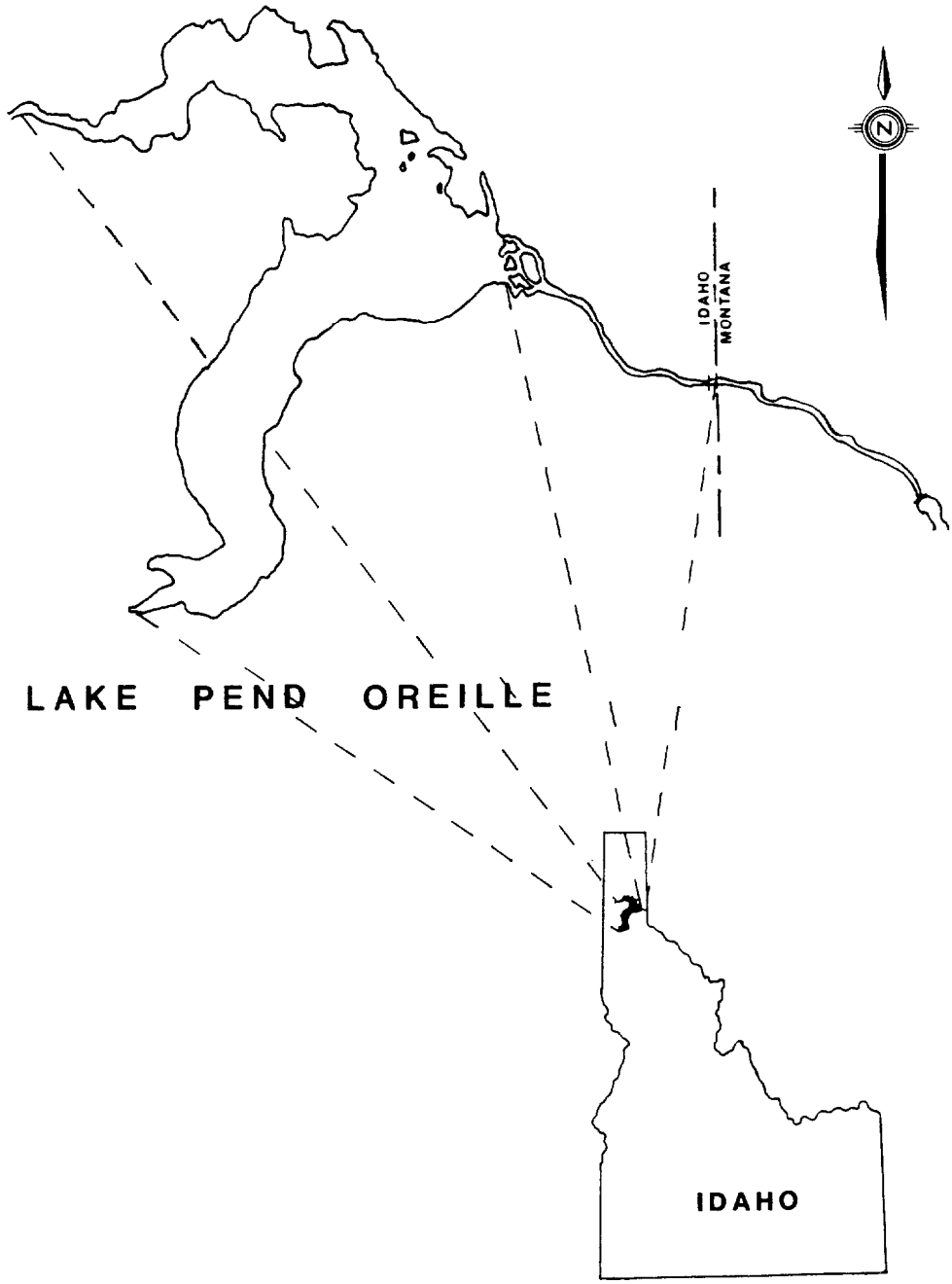


Figure 1. Map of study area.

human activity than on the lake is present throughout the year due to its proximity to Sandpoint. Portions of this upper section of the river may freeze over for short periods during the winter months.

The Lake Pend Oreille fishery supports populations of non-native kokanee salmon, rainbow trout (Salmo sairdneri), cutthroat trout (Salmo clarki), Dolly Varden (Salvelinus confluentis), brook trout (Salvelinus fontinalis), mackinaw (Salvelinus namavcush), Lake Superior whitefish (Coreoonas cluoeaformis), mountain whitefish (Prosopium williamsoni), largemouth bass (Micropterus salmoides), northern squawfish (Ptvchocheilus oresonensis), largescale sucker (Catostomas macrocheilus), and others (Bowles et al. 1987). The area is also frequented by large numbers of migrating waterfowl until the formation of ice in the shallow portions of the lake begins to limit their food accessibility.

METHODS AND MATERIALS

BALD EAGLE ABUNDANCE AND DISTRIBUTION

Weekly aerial censuses were conducted from late October (1986) and early November (1985) to early April to determine total numbers, age class composition, and seasonal distribution of bald eagles within the study area. The census route was from the delta of the Clark Fork River, Idaho, upstream to Noxon Rapids Dam, Montana, (50 km) and return (the higher of the counts used in the final tally), the shoreline of Lake Pend Oreille and its islands (184 km), and the Pend Oreille River from Sandpoint downstream to Smith Creek (12 km) (Fig. 2). During the spring of 1985-86 and the field season of 1986-87, one flight per month was extended further downstream to Albeni Falls Dam (45 km).

Censuses were flown in fixed-wing aircraft (Cessna 185) at 105-140 km/hr and 75-125 m above the water. The pilot was usually accompanied by two observers: one seated in the front (spotter), and one seated in the rear of the aircraft (recorder). The spotter called out and recorded on a tape recorder the age classes (adult: fully white head and tail; subadult: all other combinations of body plumage), numbers, locations, perch tree species and/or activities of bald eagles which were passed along the census route. The recorder assisted in spotting eagles, and followed the progress of the flight on 7.5 min U.S. Geologic Survey (USGS) topographic maps (1:24,000 scale), while recording onto them data called out by the spotter. In isolated instances where large numbers of eagles were concentrated and the possibility of not observing some eagles increased, the aircraft was circled back sharply for an immediate recount of the area in question. The beginning and ending times of each flight, weather data (temperature, precipitation, wind velocity and direction), activity at eagle nest sites, and other pertinent information were recorded onto aerial census forms (Appendix A-l).

Censuses began between 2.6 hrs and 6.2 hrs after sunrise ($\bar{x}$ = 4.2 hrs). Unfavorable flight conditions (high winds, turbulence, poor visibility) during many mornings prevented a standardized departure time and sometimes resulted in a one- or two-day postponement 'or cancellation of the flight until the following week. Census duration for the normal weekly route averaged 2.8 hrs.

A geographic information system (COMARC 1986) was used to document eagle distribution. Base maps were created by digitizing the shoreline of the lake from USGS 7.5 and 15 min topographic maps. Eagle locations previously

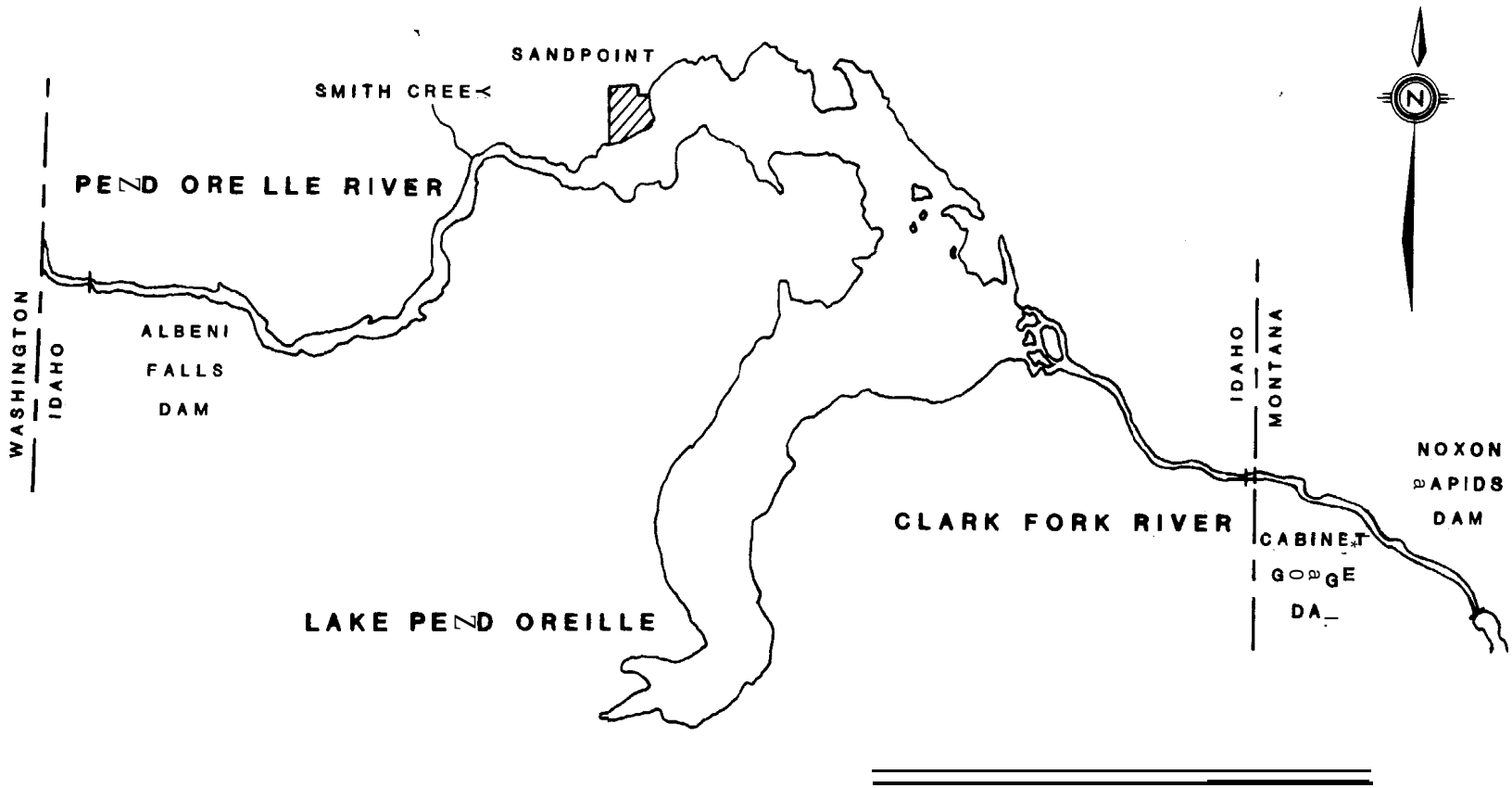


Figure 2. Map of area covered in aerial censuses of bald eagles, 1985-86 and 1986-87.

recorded onto aerial census maps were digitized to create additional overlays which were then expanded with corresponding data on eagle age classes, activities, and perch tree species. A single map of each weekly census of Lake Pend Oreille was generated to provide an illustration of eagle abundance and distribution as the concentration progressed through the winters of 1985-86 and 1986-87. The system was also used to total the species and structure of perch trees used by bald eagles at the time of the census.

Differences in eagle distribution were examined by dividing the lake and river shoreline into units of one mile (lake-mile [LM]; river-mile [RM]). For more detailed analysis of distribution on the lake, the time spanned by the concentration periods was divided into intervals of 54 days each (early winter: 24 October to 16 December; mid-winter: 17 December to 8 February: late winter: 9 February to 3 April). A Kolmogorov-Smirnov test (SYSTAT, Inc. 1986) was used to test for significant differences (of = 0.05) in the cumulative distributions of eagle numbers between years.

CAPTURE AND MOVEMENTS OF BALD EAGLES

Bald eagles were captured with a floating kokanee salmon equipped with two monofilament nooses that extended laterally from the fish just above the surface of the water, as modified after Frenzel and Anthony (1982) (Fig. 3). A monofilament line tied to the nooses extended into the water to a depth of 10–20 m where it was connected to 1.5 m of elastic cord (6 mm diameter) attached to a 2 kg cement anchor.

Capture attempts began about sunrise from a boat by positioning 1–4 capture fish 15-50 m offshore from popular eagle perch sites. Observers then returned to a vantage point on shore to await an eagle's arrival. When a flying eagle descended and grasped the fish, its toe(s) and/or tarsus were usually encircled by one of the nooses. As tension increased on the line with the attempted departure of the eagle, the nooses closed and the eagle was pulled gently to the water's surface.

Captured eagles were approached immediately by boat and retrieved from the. water with a large fish net (1.0 m diameter). They were hooded to minimize stress while being handled, restrained by securing a triangular bandage around the wings and body and by tethering the tarsi together with nylon cord, and wrapped in a wool blanket to help maintain body temperature and allow feathers to dry. Before leaving the site, capture equipment was removed from the water. Eagles were then transported to shore to undergo a series of

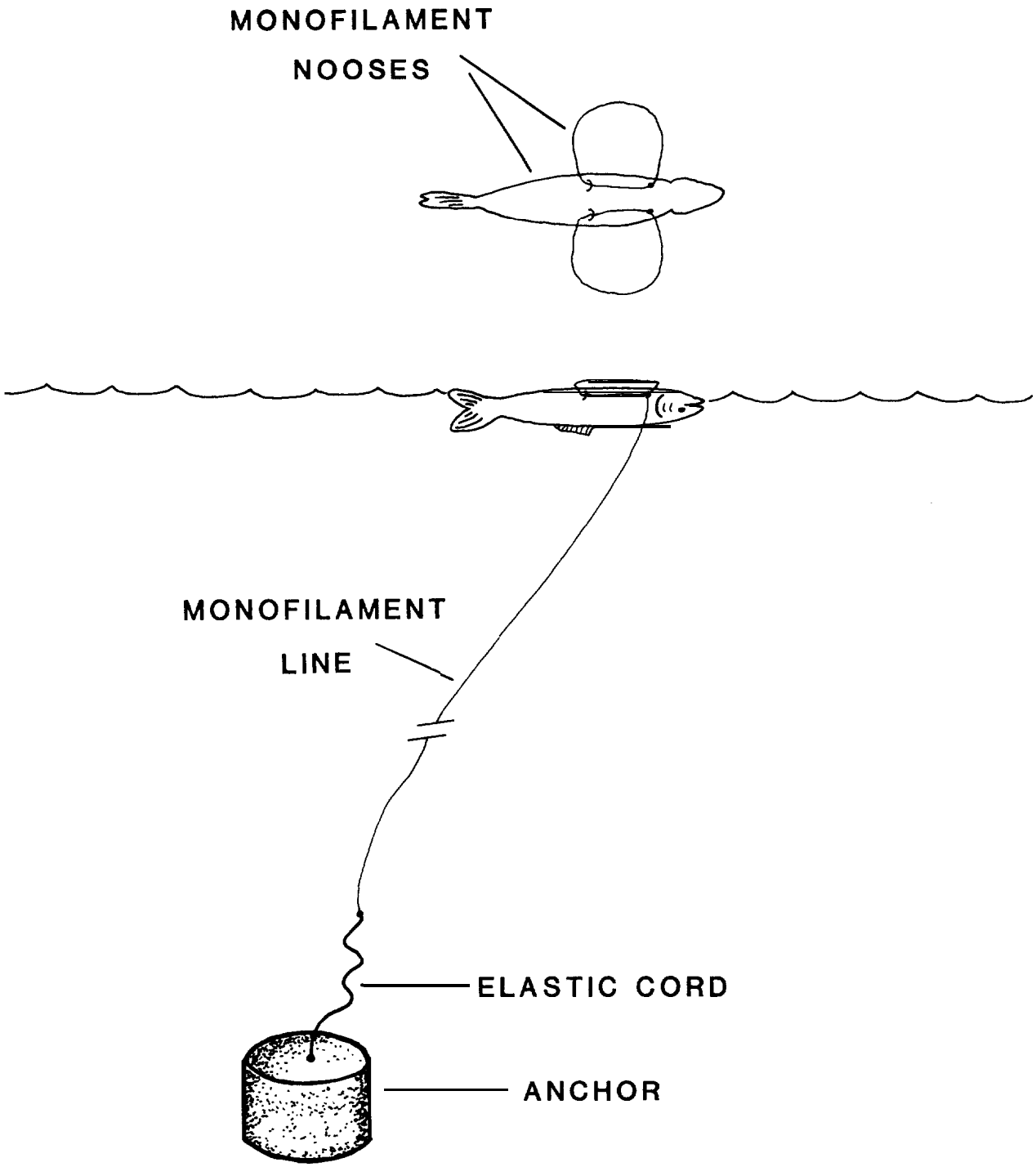


Figure 3. Floating kokanee salmoncapture syskmforbaldeagles.

morphological measurements (Appendix A-2) for judging relative health condition and determining sex (Bortolotti 1984). U.S. Fish and Wildlife Service No. 9 aluminum bands were attached around one tarsus of each eagle.

Captured eagles were equipped with patagial wing-markers and radio-transmitters. Wing-markers were bright green, made of vinyl-coated nylon (Cooley Inc., Anaheim, California), and numerically coded (01 to 08) dorsally with white gloss paint (Naz-Dar Co., Chicago, Illinois). Each wing-marker wrapped around the wing next to the body at a natural gap in the feathers and was held in place by an aluminum rivet through the terminal (posterior) ends of the marker. Radio-transmitter packages (Telonics, Inc., Mesa, Arizona) weighed 60 g, had an operational life of 15 months, and were attached to each eagle in backpack configuration with 1.4 cm teflon ribbon (Bally Ribbon Mills, Bally, Pennsylvania). Waxed dental floss (Johnson and Johnson Products, New Brunswick, New Jersey) was used to secure the loose ends of the ribbon to each other at the base of the transmitter package after they encircled the eagle's body and to affix the point where the ribbon criss-crossed above the eagle's sternum.

Eagles were released near the capture site and observed for as long as possible to ensure no adverse effects from the capture and handling procedures. Movements of transmitter-equipped eagles were obtained by following signals during weekly census flights for final telemetry or visual confirmation and by radio-tracking and triangulation from a boat, by automobile, or on foot. Eagle locations were plotted on 7.5 min USGS topographic maps and characterized on data forms (Appendix A-3). Locations were evaluated based upon their type (visual or triangulation) and the degree of accuracy obtained (Heezen and Tester 1967); those locations suspected of being inaccurate were used only for providing a general area from which to begin the next radio-tracking session.

NOCTURNAL ROOSTS

Night locations of bald eagles were identified by observing eagles' flight paths and destinations after they left popular feeding sites at dusk, and by observations of eagles at previously identified roost sites. Additional roost locations and data on roost fidelity by individuals were documented by observing the roost flights of transmitter-equipped eagles or by triangulation on their night locations between one hour after sunset and one hour before sunrise. Location of roosts and roost trees frequently used by eagles were plotted on 7.5 min USGS

topographic maps. Height of roost trees was measured with a clinometer; diameter at breast height (dbh) was measured with a diameter tape.

HABITAT DESCRIPTION

Detailed habitat information on lands adjacent to Lake Pend Oreille, the lower Clark Fork River, and the upper Pend Oreille River was not available, therefore, a general description of these lands was used to characterize bald eagle habitat. USFS personnel provided a description of the area based upon aerial photo interpretation and limited forest stand data for two habitat use zones: 1) shoreline zone: a 100 m wide band along the shoreline of the lake and rivers, 2) upland zone: a 1.6 km wide band adjoining the shoreline zone. The shoreline zone encompassed areas of considerable daily activity that bald eagles used for feeding, perching, and hunting. The upland zone included secondary use areas that were used for roosting and loafing, and where a higher degree of security from disturbance for bald eagles could be maintained. Both zones were subjectively divided into the same 25 units based upon major differences in topographic and habitat characteristics (Fig. 4). Each unit was described in terms of habitat type (Cooper et al. 1985), estimated percent of unforested and forested land (old-growth, mature, and younger timber classes), estimated mean height and density of upper canopy trees, most common slopes, land ownership, and proposed management plans for USFS land (U.S. Forest Service 1985).

BEHAVIORAL ACTIVITY BUDGETS

Bald eagle behavior was documented during weekly day-long observation sessions at sites of intense eagle activity. Portable blinds were used to hide the observer and minimize disturbance. Observation sites were initially chosen to correspond with eagle distribution noted in the weekly aerial censuses and were used alternately throughout the 1985-86 field season until eagle activity at a site diminished significantly. In the winter of 1986-87, eagle behavior was documented only at the mouth of Granite Creek (Fig. 5). Some sites of intense eagle activity were excluded as potential observation sites due to their inaccessibility to observers, too great a distance for observation to be effective, or a lack of suitable locations from which observations might be conducted.

Observation sessions usually began approximately 30 minutes before sunrise and were terminated after sunset when eagles were no longer present. The activity (state) of each

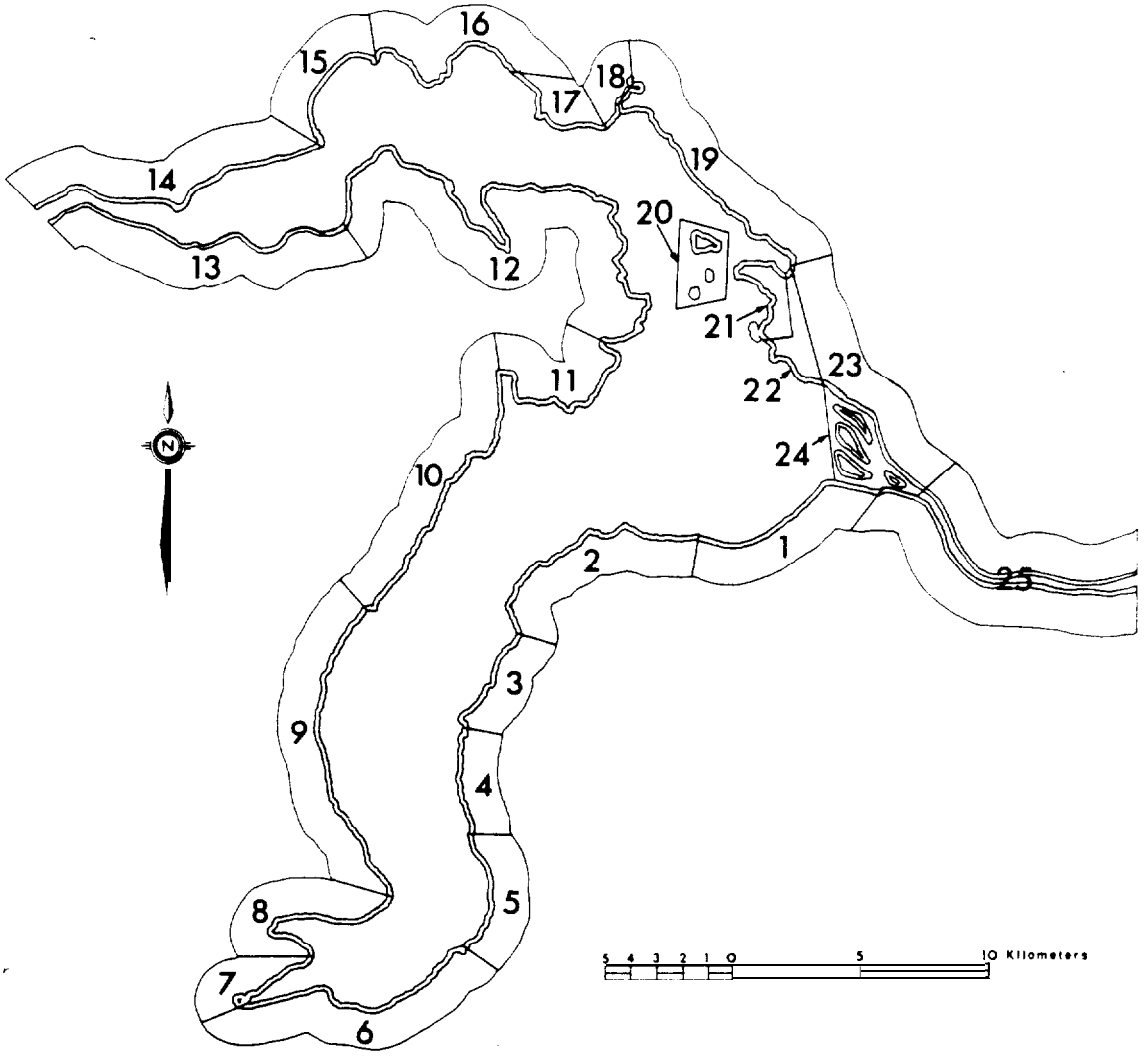


Figure 4. Map of habitat use zones on Lake Fend Oreille.

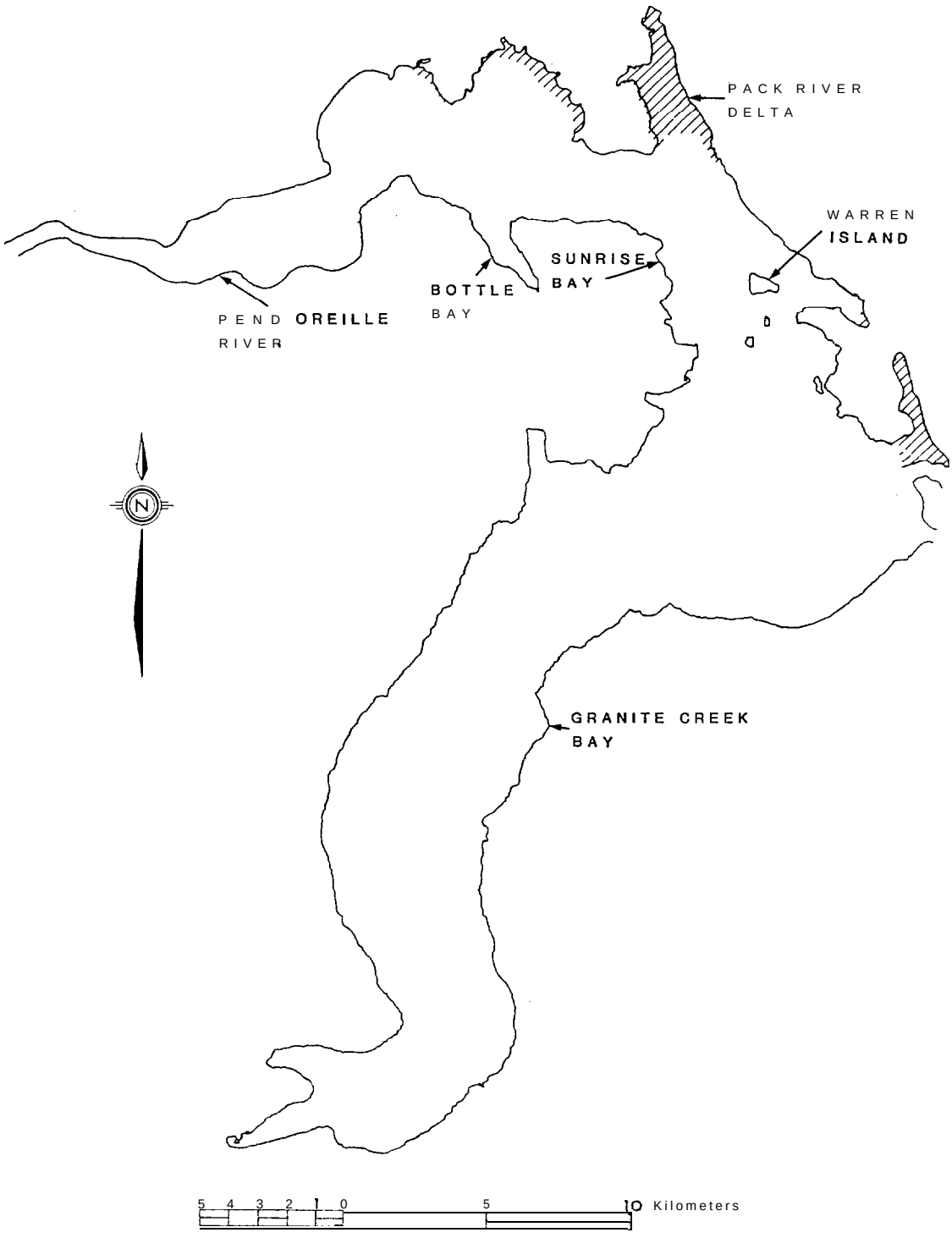


Figure 5. Locations of observation sites for bald eagle behavioral activity budgets, 1985-86 and 1986-87.

eagle in view was recorded (in coded form) as the observer scanned the site every five minutes (Altmann 1974) (Appendix A-4). Eagles observed were classified as either adults or subadults.

FEEDING HABITS

Foraging events of bald eagles were additionally recorded independently of the 5-min activity scan during each observation session to provide a detailed record of the frequency and success rate of capture attempts by bald eagles, and to add to a list of prey species taken by bald eagles.

Pellets of undigested food materials cast up by bald eagles at two major nocturnal roosts and remains of prey discarded by eagles at diurnal feeding perches were located by searching under roost and perch trees and by walking shoreline transects. Materials collected were labeled for laboratory analysis. Pellets were soaked in a weak (10%) sodium hydroxide solution or soapy water to aid in separation of materials and analyzed by methods described by Errington (1932). Mammalian prey items in pellets were identified by examination of guard hairs (Stains 1958). Fish items were identified by examination of scales (Casteel 1972) and body parts (Brown 1971, Simpson and Wallace 1978).

SALMON CARCASS AVAILABILITY FROM CABINET GORGE HATCHERY

To determine the future availability to wintering bald eagles of artificially-spawned kokanee salmon processed at the Cabinet Gorge Hatchery, salmon carcasses were released into the Clark Fork River adjacent to the hatchery and their progress downstream monitored. Salmon were marked with numerically- and color-coded tags of plastic ribbon (2 cm x 16 cm) that were stapled to the opercle of each fish. Carcasses were marked at Granite Creek immediately after being artificially spawned, then packed in ice or snow, and transported to the hatchery. Live, artificially-spawned salmon were anaesthetized with MS-222 and either marked at the hatchery where they were placed in a holding pond, or at Granite Creek where they were placed in an aerated water tank and transported by truck to the hatchery.. Live salmon were allowed to expire just prior to release..,, All carcasses were released 10 m offshore (3-5 m depth) from the hatchery fish ladder at the approximate location of future releases or in mid-channel of the river (>15 m depth).

Movement of tagged carcasses downstream was monitored by searching from boats for those that had become stranded along the shoreline and shallows of the river. Surveys were conducted when low flows were anticipated during a minimum of three days following each release. Drift nets were positioned across two side channels to reduce survey time. Initially, surveys were conducted from the release site to the Clark Fork River delta (10 RMs), but some later surveys were terminated near the mouth of the south channel of the river (8 RMs) due to problems in safely maneuvering boats through the braided channels of the lower sections of the river, particularly at low flows. The tag number and/or color, location, percent of flesh remaining, and availability of carcasses to bald eagles were recorded for all located markers.

RESULTS AND DISCUSSION

BALD EAGLE ABUNDANCE AND DISTRIBUTION

Total Study Area

Aerial censuses of bald eagles within the study area were conducted from 7 November 1985 to 3 April 1986 (N = 19) and from 24 October 1986 to 3 April 1987 (N = 23). In both years of the study, migrant bald eagles began to arrive in the area in late October or early November, and departed by early April (Fig. 6). Eagle numbers increased, peaked, and declined later in the concentration period in 1985-86 than in 1986-87. The number of weeks (N = 22) that elapsed between the first and last census of greater than 25 eagles (which excludes early censuses consisting primarily of resident eagles) was equal for both years of the study, indicating concentration periods of approximately equal duration.

Peak eagle numbers in 1985-86 (274) were recorded two weeks later than in 1986-87 (429) (Table 1). The timing of the peaks is similar to that for concentrations of wintering eagles in other parts of the U.S. (Spencer 1976); weekly variations in eagle numbers as evidenced during both winters have been attributed elsewhere to weather conditions on census days, migratory movements, and availability of prey (Southern 1963, Shea 1973, Servheen 1975).

The 1985-86 peak in numbers of adults (228) occurred one week later than the subadult peak (65); peak counts occurred on the same date for both adults (364) and subadults (65) in 1986-87. Adult bald eagles outnumbered subadults in all censuses throughout both years (Figs. 7 and 8). The mean percentage of subadult bald eagles counted in 1985-86 censuses was 18.1%; similar to the 18.5% counted in 1986-87 (Fig. 9). These values are lower than the 30% subadults that is typical in wintering populations in Washington (Hancock 1964, Stalmaster et al. 1979), Utah (Edwards 1969), and Montana (McClelland 1973), and much lower than the 60% subadults found in Arizona (Grubb 1984).

Mid-January censuses of bald eagles on Lake Pend Oreille, the lower Clark Fork River below Cabinet Gorge Dam, and the upper Pend Oreille River, which were conducted as part of the National Wildlife Federation's nationwide bald eagle surveys since they were begun in 1979, increased significantly ($P < 0.050$) in 1986 and 1987 above previous censuses. The counts in 1986 (265) and 1987 (266) were significantly higher ($P < 0.050$) than the mean count for 1981 to 1984 ($\bar{x} = 88.4$) (Fig. 10) (IDFG internal document). This increase may be due in small part to increased

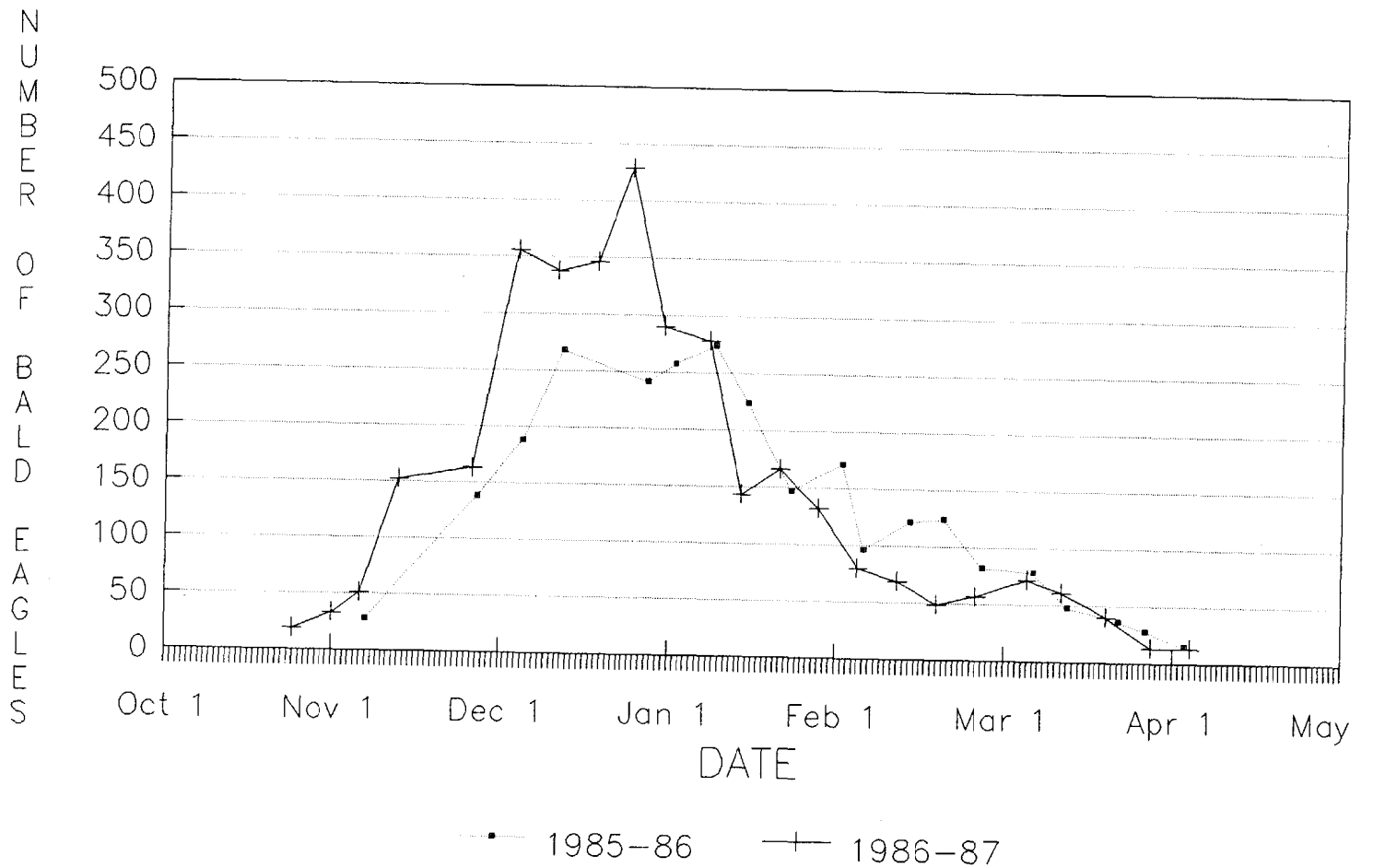


Figure 6. Numbers of bald eagles in aerial censuses of the study area, 1985-86 and 1986-87.

Table 1. Peak counts of bald eagles in aerial censuses of the study area, 1985-86 and 1986-87.

	Year			
	1985-86		1986-87	
Age class	Peak count	Date	Peak count	Date
Combined	274	9 Jan.	429	24 Dec.
Adult	228	9 Jan.	364	24 Dec.
Subadult	65	2 Jan.	65	24 Dec.

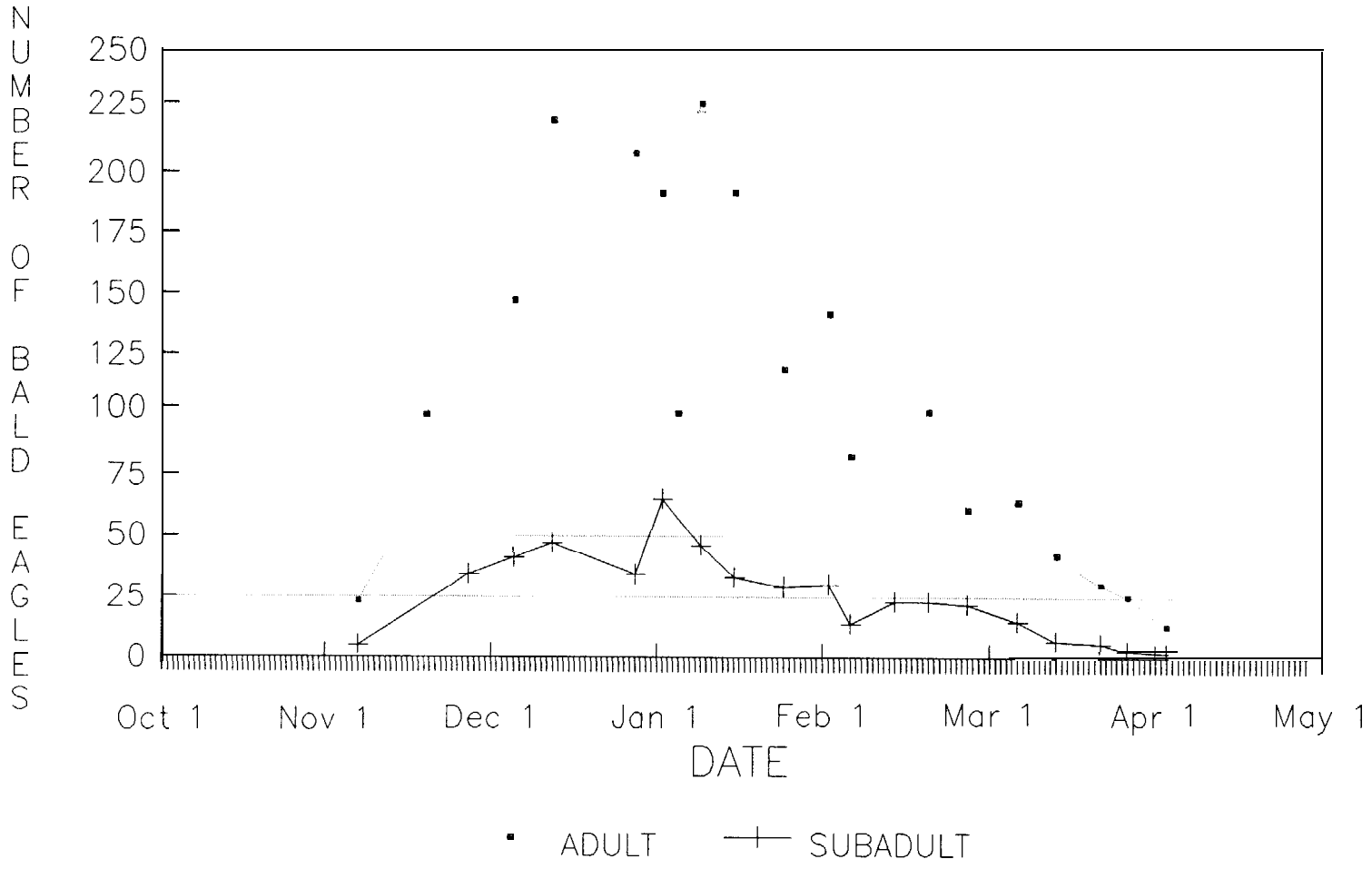


Figure 7. Numbers of adult and subadult bald eagles in aerial censuses of the study area, 1985-86.

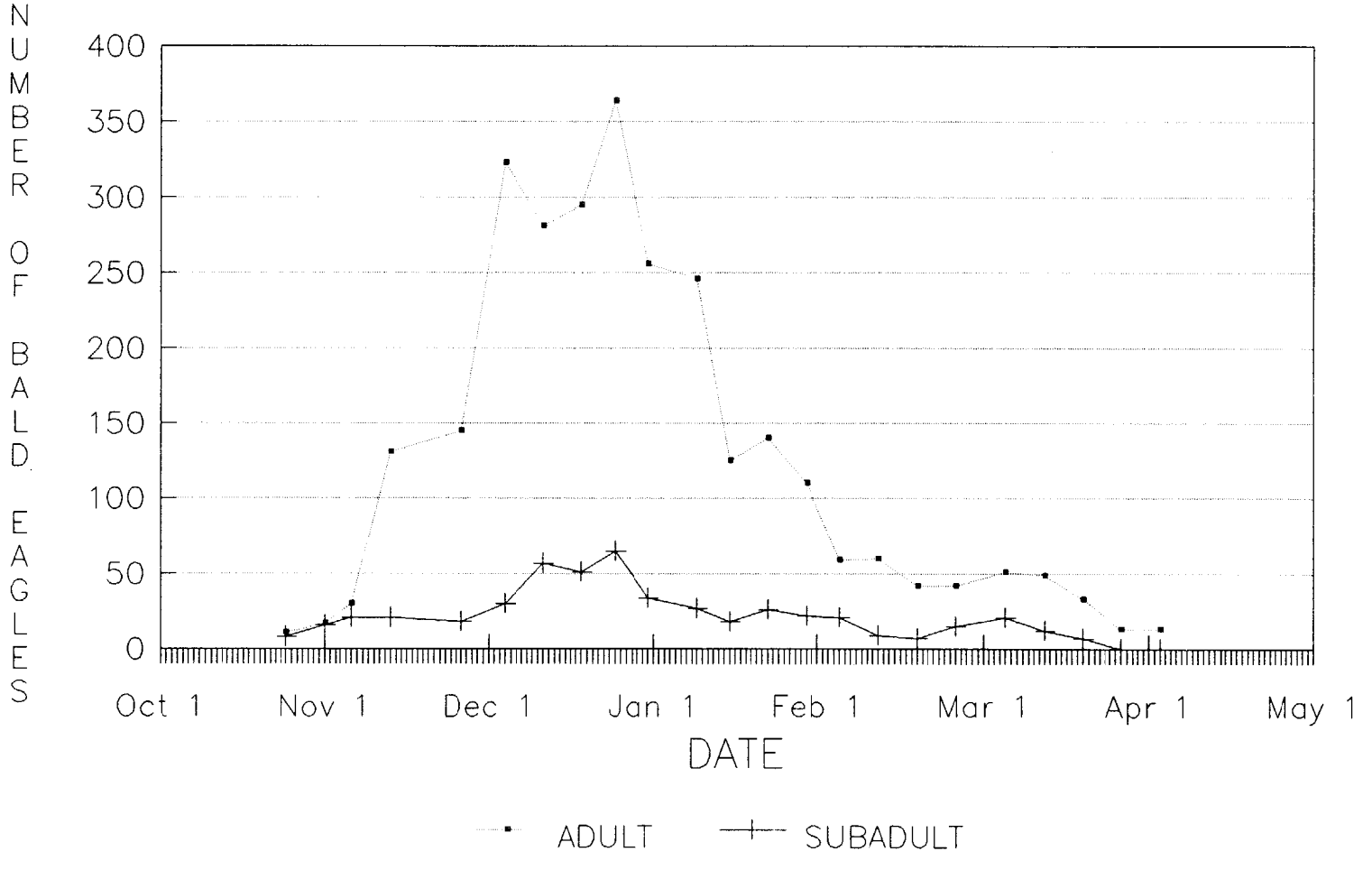


Figure 8. Numbers of adult and subadult bald eagles in aerial censuses of the study area, 1986-87.

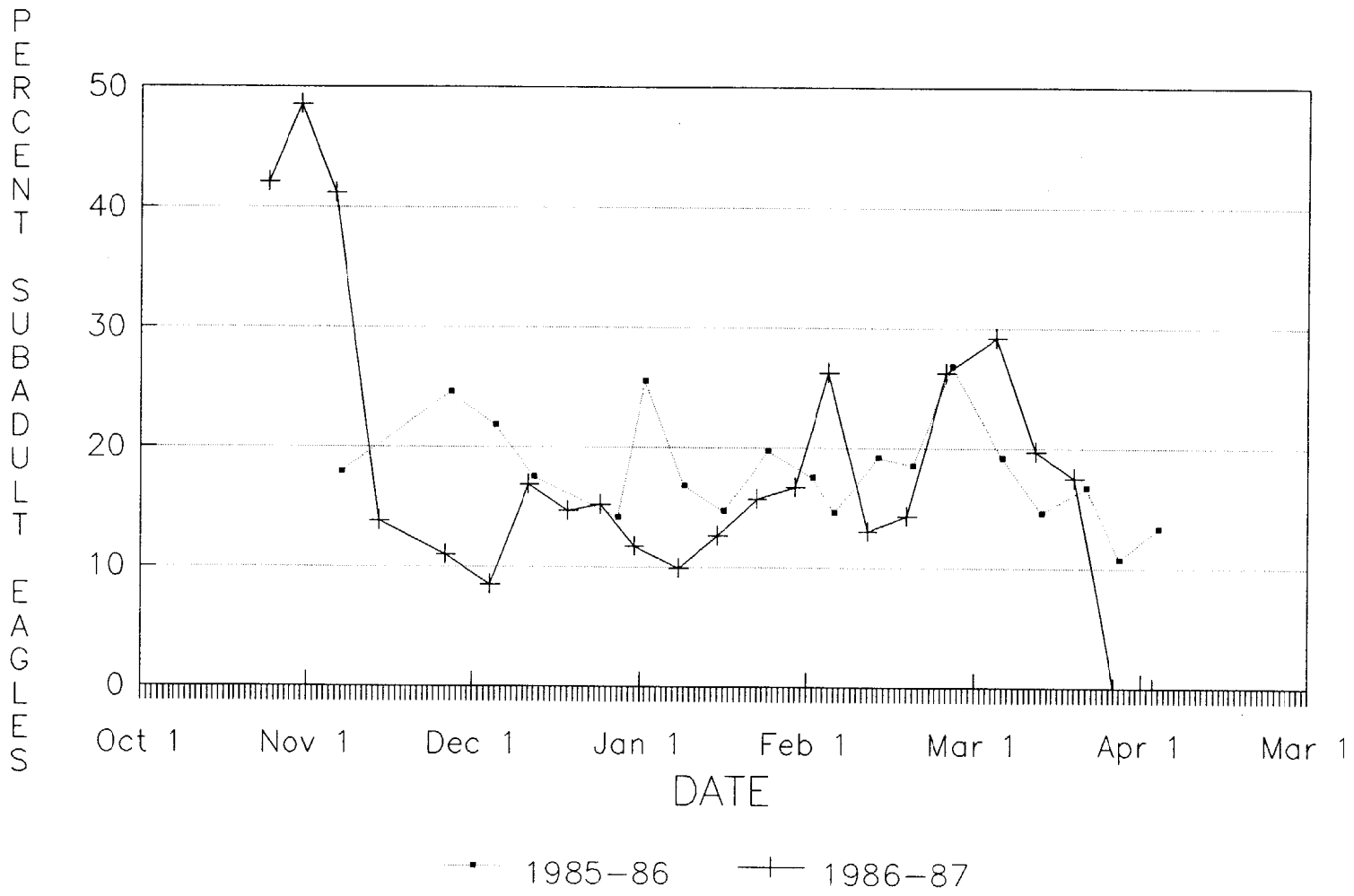


Figure 9. Percent subadult bald eagles in aerial censuses of the study area, 1985-86 and 1986-87.

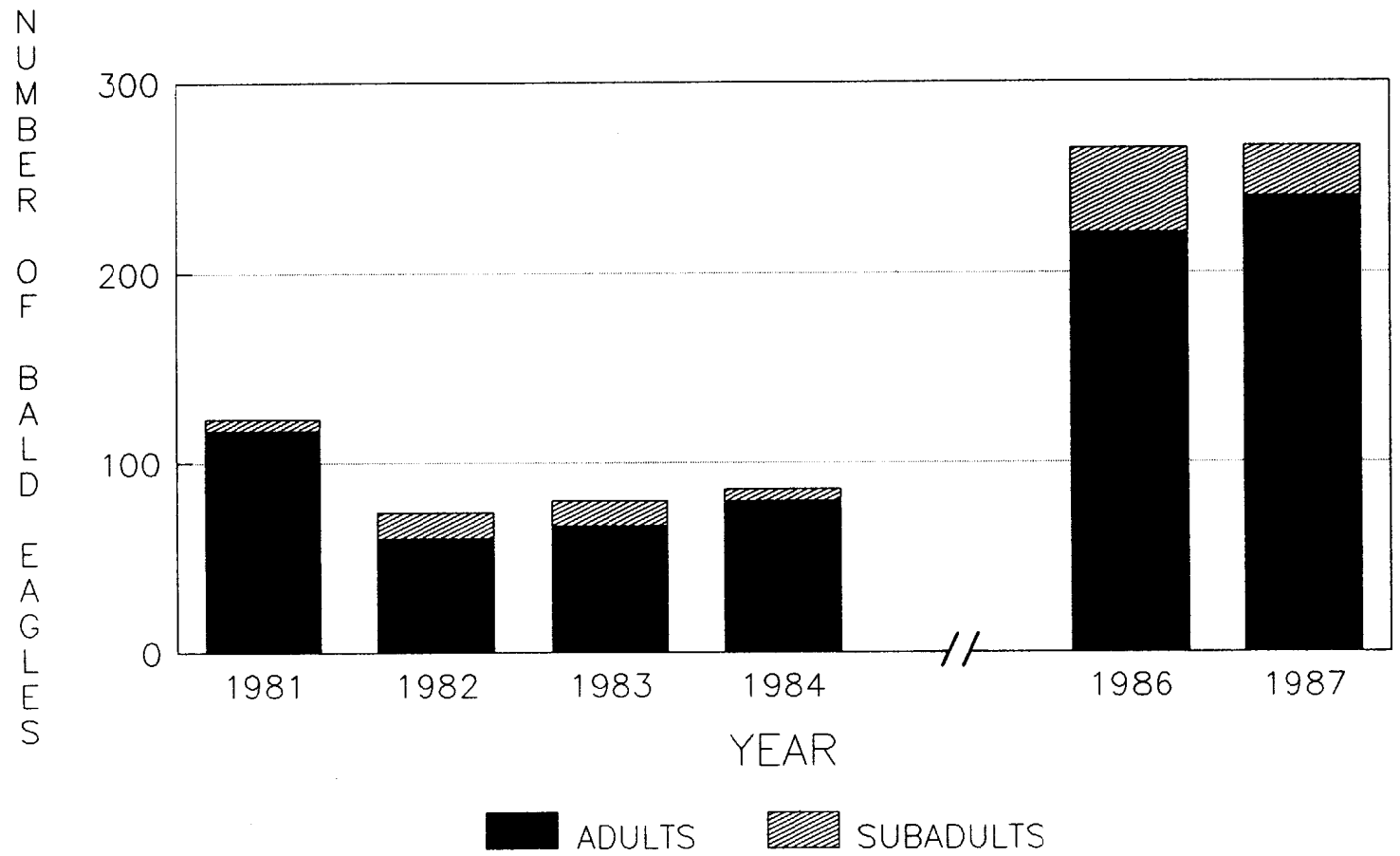


Figure 10. Mid-winter bald eagle censuses of the study area, excluding upstream of Cabinet Gorge Dam, 1981-84 and 1986-87.

familiarity with the census route in 1986 and 1987 by those conducting the census, or by having a concentration period in which the peak in eagle numbers did not correspond to the census date, as occurred in 1987. The 1986 and 1987 mid-January counts contributed an average of 34% of the total number of eagles counted in Idaho in the National Wildlife Federation's surveys and approximately 2% of the number counted nationwide.

Lake Pend Oreille

Most of the eagles counted in the censuses of the study area were found along the shoreline of Lake Pend Oreille in 1985-86 ($\bar{x}$ = 74.8%) and 1986-87 ($\bar{x}$ = 67.0%) (Appendix B). The peak census of eagles on the lake in 1985-86 was lower and occurred earlier than the peak in 1986-87 (Table 2; Fig. 11).

Areas used by bald eagles along Lake Pend Oreille were classified based on the mean number of eagles sighted along each LM in aerial censuses conducted during each of the two concentration periods (Table 3). In 1985-86, heavy use areas were restricted to 12 LMs in the northern half of the lake; individual LM counts ranged from 8-25 eagles per census (Fig. 12). Areas of moderate use were located throughout the remainder of the lake excluding the southwest shoreline. Nearly all other remaining LMs received light use; three LMs were not used by eagles.

In 1986-87, eagle distribution differed (P = 0.095) from 1985-86. Areas of heavy use were distributed to a lesser extent in northern Lake Pend Oreille, and were found near the mouth of Granite Creek and in the southernmost parts of the lake at Echo Bay. More LMs were heavily-used than during the previous year, but the mean number of eagles per census was similar. Individual LM counts in heavy use areas ranged from 8-39 eagles per census. Many areas classified as moderate were similar to those identified in the previous year. Light use was recorded at all but one of the remaining LMs in which no eagles were counted. Distribution of eagles per LM by winter period was significantly different between years (early: $P < 0.001$; mid-: $P = 0.035$; late: $P < 0.001$).

Eagle distribution between years in the northern half of the lake was significantly different only during early winter (P = 0.027); the mean number of eagles per LM in 1985-86 censuses (3 = 1.73) was higher than the mean in 1986-87 ($\bar{x}$ = 1.02) (Fig. 13). In the southern half of the lake, significant differences were found during both early (P = 0.025) and late winter ($P < 0.001$) between years: during early winter the mean number of eagles per LM was

Table 2. Peak counts of bald eagles in aerial censuses of Lake Pend Oreille, the lower Clark Fork River, and the upper Pend Oreille River, 1985-86 and 1986-87.

	Year			
	1985-86		1986-87	
Location	Peak count	Date	Peak count	Date
Lake Pend Oreille	251	12 Dec.	352	24 Dec.
Clark Fork River	34	2 Jan.	48	24 Dec. 8 Jan.
Pend Oreille River	36	2 Feb.	29	24 Dec.

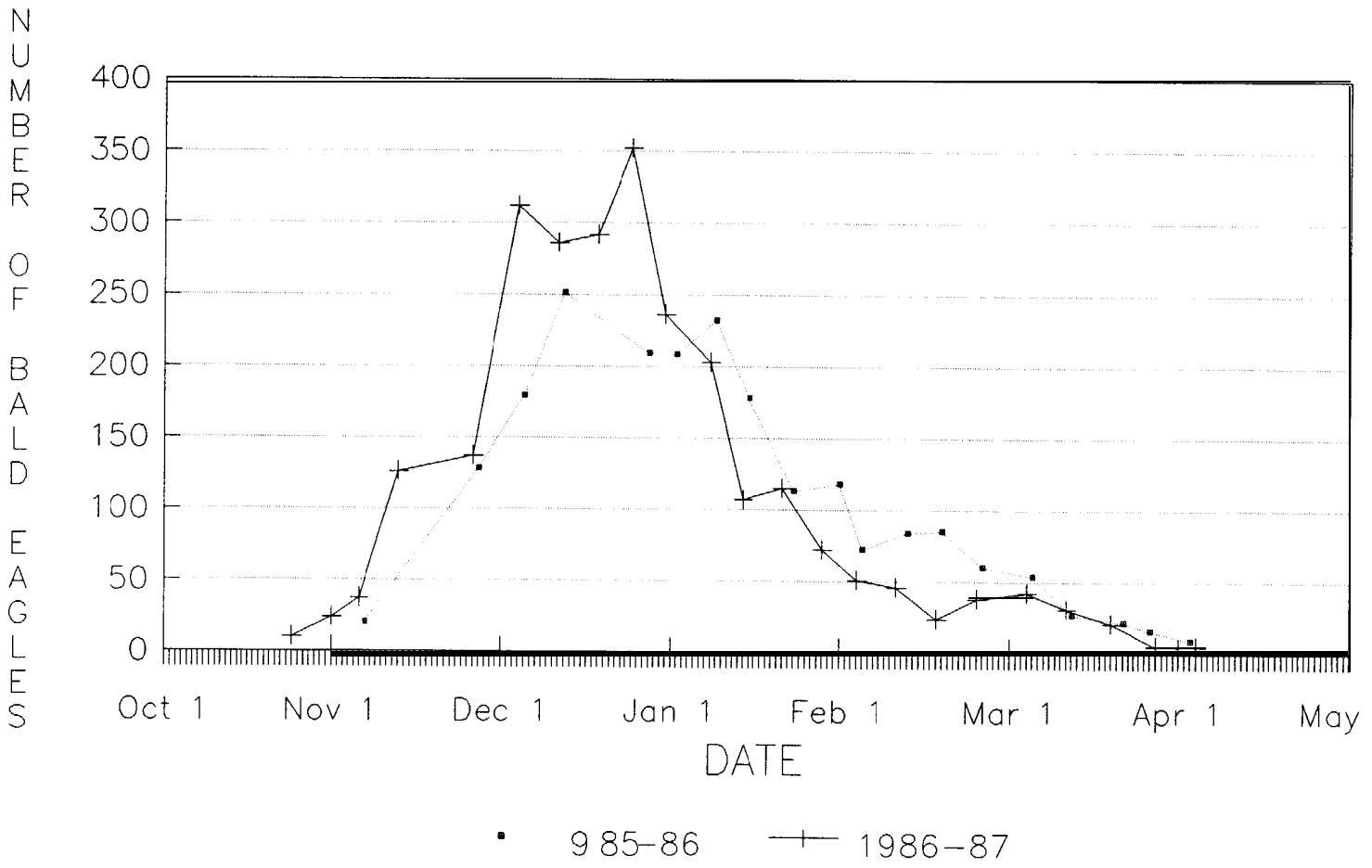


Figure 11. Numbers of bald eagles in aerial censuses of Lake Pend Oreille, 1985-86 and 1986-87.

Table 3. Description of bald eagle use areas by lake-mile LM) on Lake Pend Oreille, 1985-86 and 1986-87.

Intensity of use		1985-86		1986-87	
Class	Mean # eagles /census/LM	# LMs	Mean # eagles /census/LM	# LMs	Mean # eagles /census/LM
Heavy	>2	12	3.4	15	3.1
Moderate	1-2	25	1.4	19	1.4
Light	<1	74	0.4	77	0.4

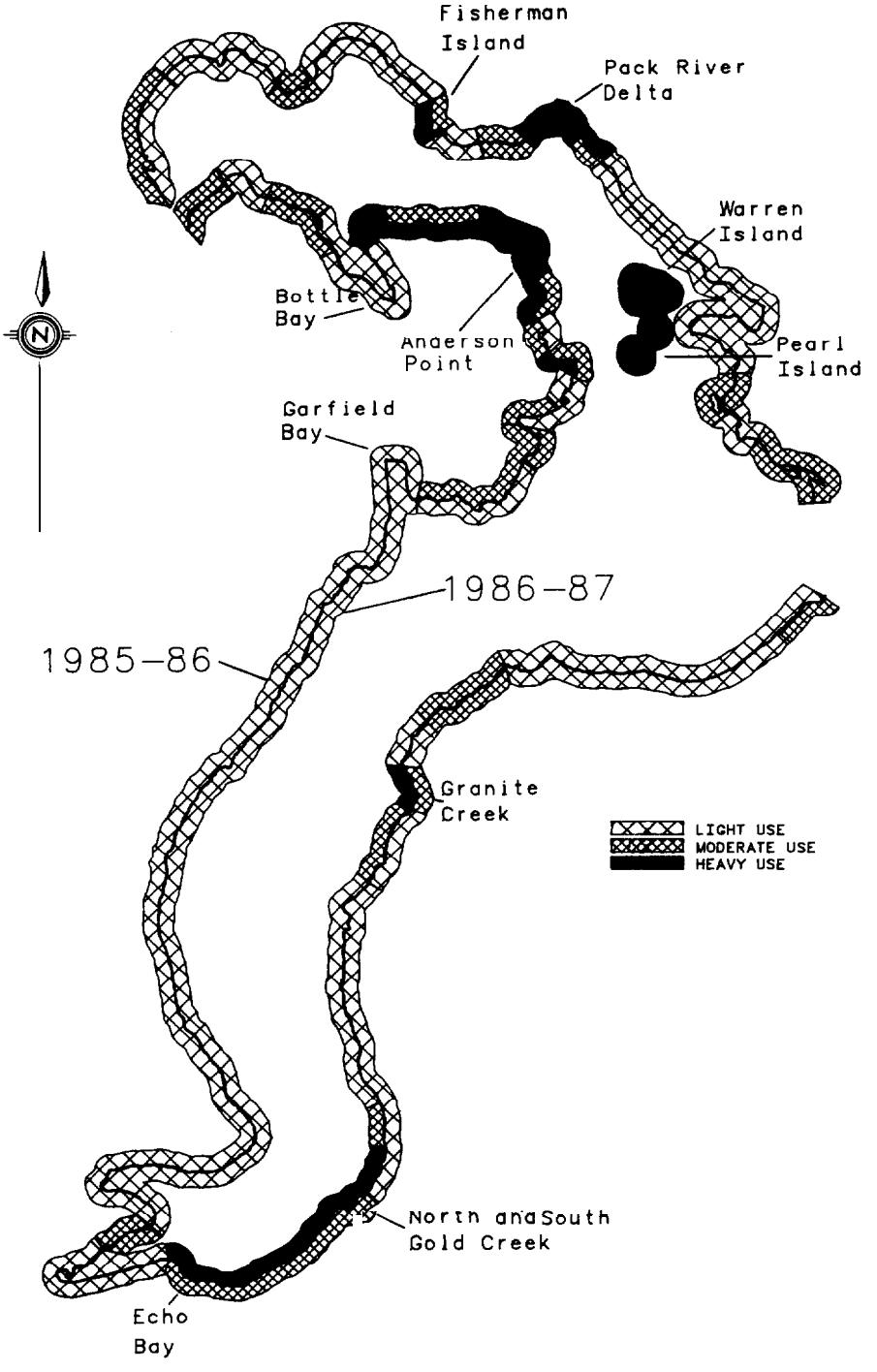


Figure 12. Distribution of bald eagle use areas on Lake Pend Oreille, 1985-86 and 1986-87.

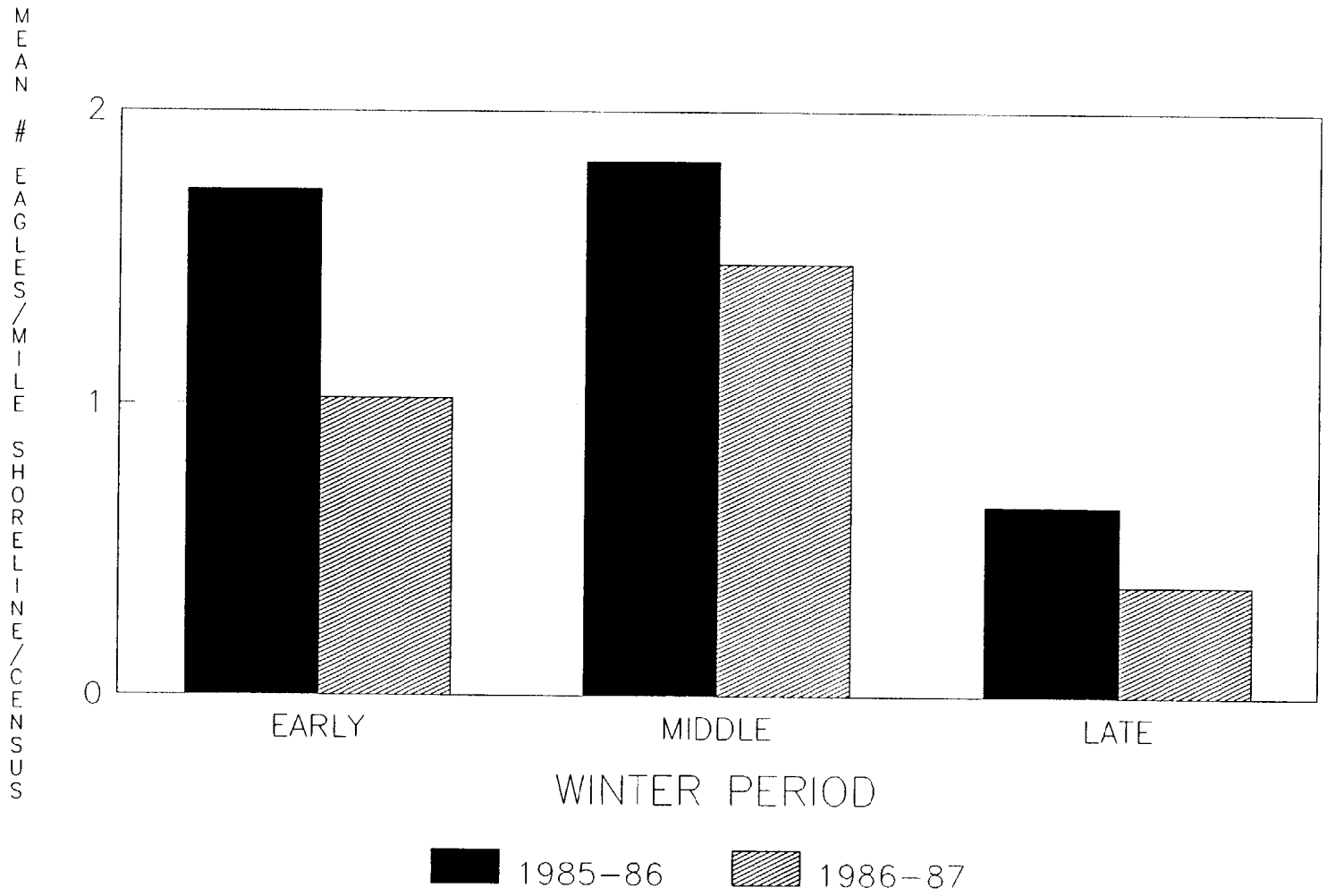


Figure 13. Mean number of bald eagles per mile shoreline on northern Lake Pend Oreille, 1985-86 and 1986-87.

lower in 1985-86 ($\bar{x}$ = 0.88) than in 1986-87 ($\bar{x}$ = 1.30), but higher during late winter in 1985-86 ($\bar{x}$ = 0.14) than in 1986-87 ($\bar{x}$ = 0.07) (Fig. 14).

Seasonal changes in eagle distribution appeared to be associated with prey availability. Large numbers of Lake Superior whitefish that died from causes associated with spawning stress in the northern parts of the lake during early winter in 1985-86 (Ned Horner, personal communication, 1987) provided an abundant food source for eagles in this area; minimal whitefish mortality was observed in 1986-87. Greater utilization of spawned-out kokanee salmon during early winter of 1986-87 than in the previous winter in the south and southeast reaches of the lake along both the shoreline and at the mouth of tributaries was indicated by increased eagle numbers at these locations; kokanee salmon escapement in the lake was similar in 1985 (366,000) and 1986 (322,000) (Bowles et al. 1987). Higher minimum temperatures in 1986-87 which prevented the formation of large areas of ice in the northern bays as occurred the previous year, contributed to greater waterfowl numbers in this part of the lake and increased use of waterfowl as part of the eagles' diet in mid- to late winter.

Clark Fork River

Eagle numbers on the Clark Fork River averaged 14.4% of the study area censuses in 1985-86 and 21.3% in 1986-87 and followed the same general pattern of use as the study area totals (Fig. 15). The peak count in 1985-86 (34) was lower than the peak in 1986-87 (48).

Most bald eagles on the river were observed along the 11 RMs between the delta and Cabinet Gorge Dam in both 1985-86 (60.5%) and in 1986-87 (62.7%) (Fig. 16). The preference of this section of river was probably due to the relative lack of river ice that would limit food availability, and the presence of migrating kokanee salmon whose travel upstream beyond the dam was prevented. Significantly more (P = 0.008) eagles were counted in 1986-87 censuses than in the previous year. This increase corresponded to greater numbers of kokanee salmon that migrated up the river in this area in 1986-87 to spawn in the Lightning Creek/Spring Creek drainage (RM 142) and adjacent to the Cabinet Gorge Hatchery (RM 150) (Bowles et al. 1987).

Pend Oreille River

The number of eagles counted on the upper Pend Oreille River made up an average of 10.6% of the 1985-86 censuses of the study area and 11.7% of the 1986-87 censuses. The peak census in 1985-86 occurred much later than the peak the following year (Table 2; Fig. 17).

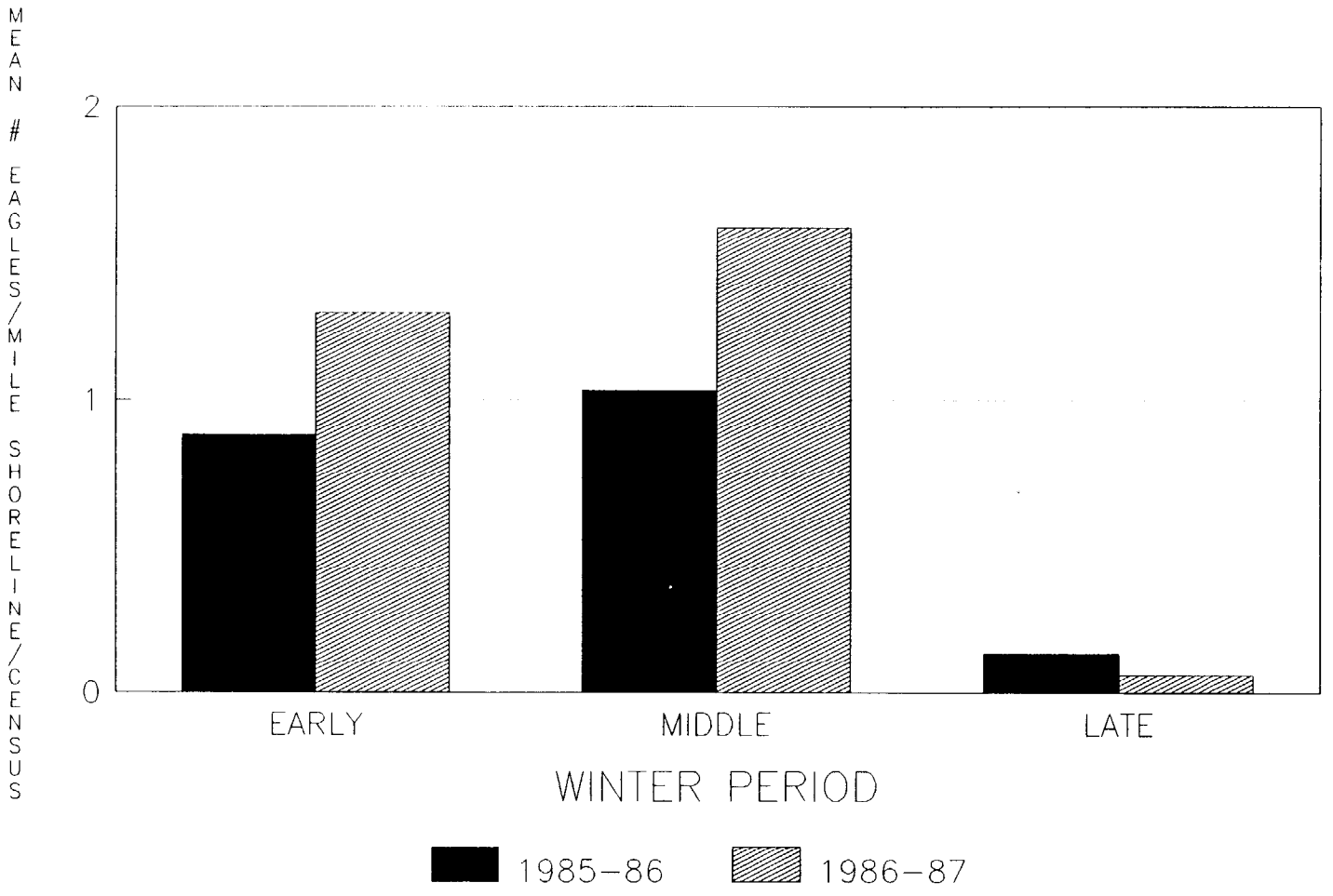


Figure 14. Mean number of bald eagles per mile shoreline on southern Lake Pend Oreille, 1985-86 and 1986-87.

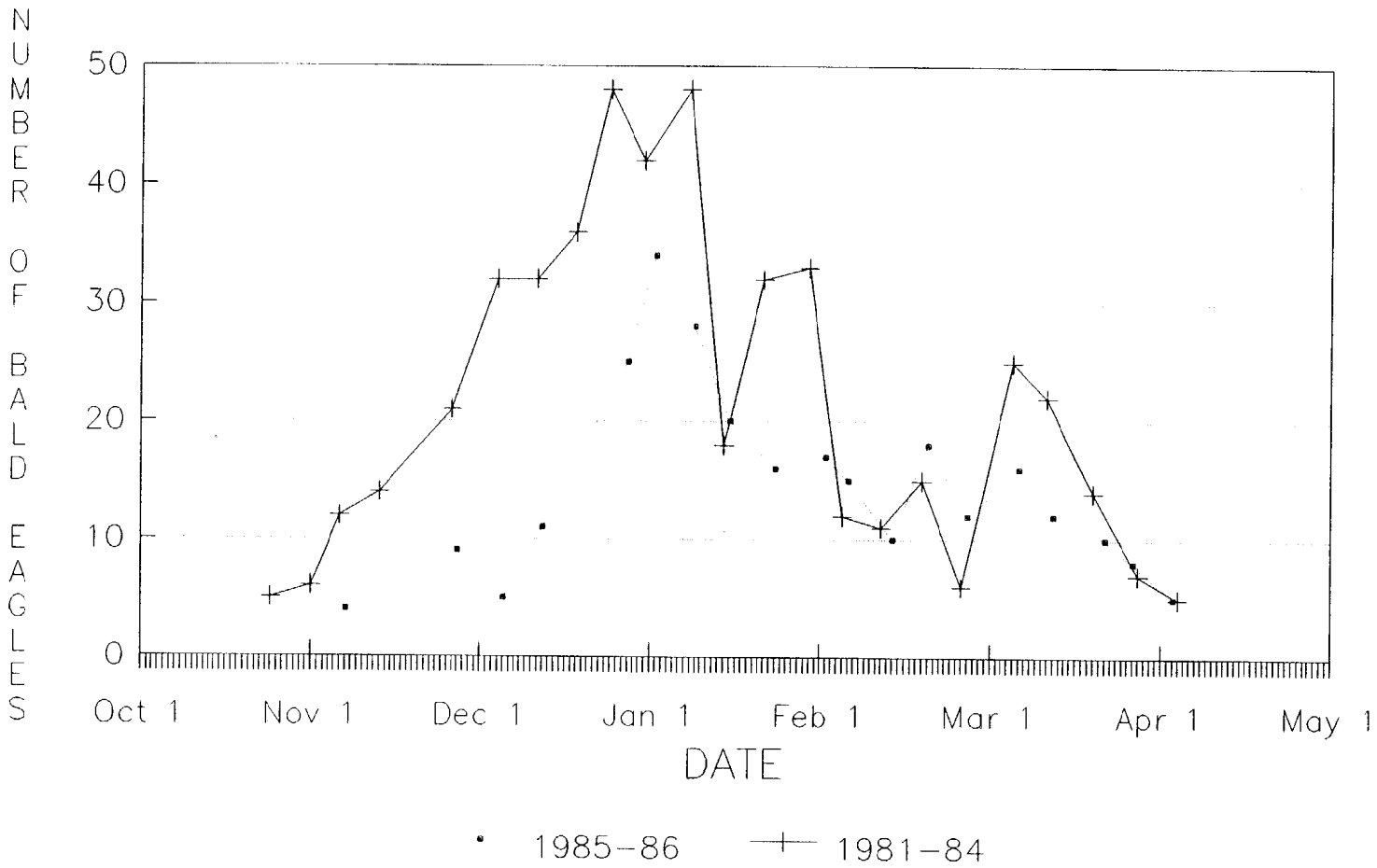


Figure 15. Numbers of bald eagles in aerial censuses of the lower Clark Fork River, 1985-86 and 1986-87.

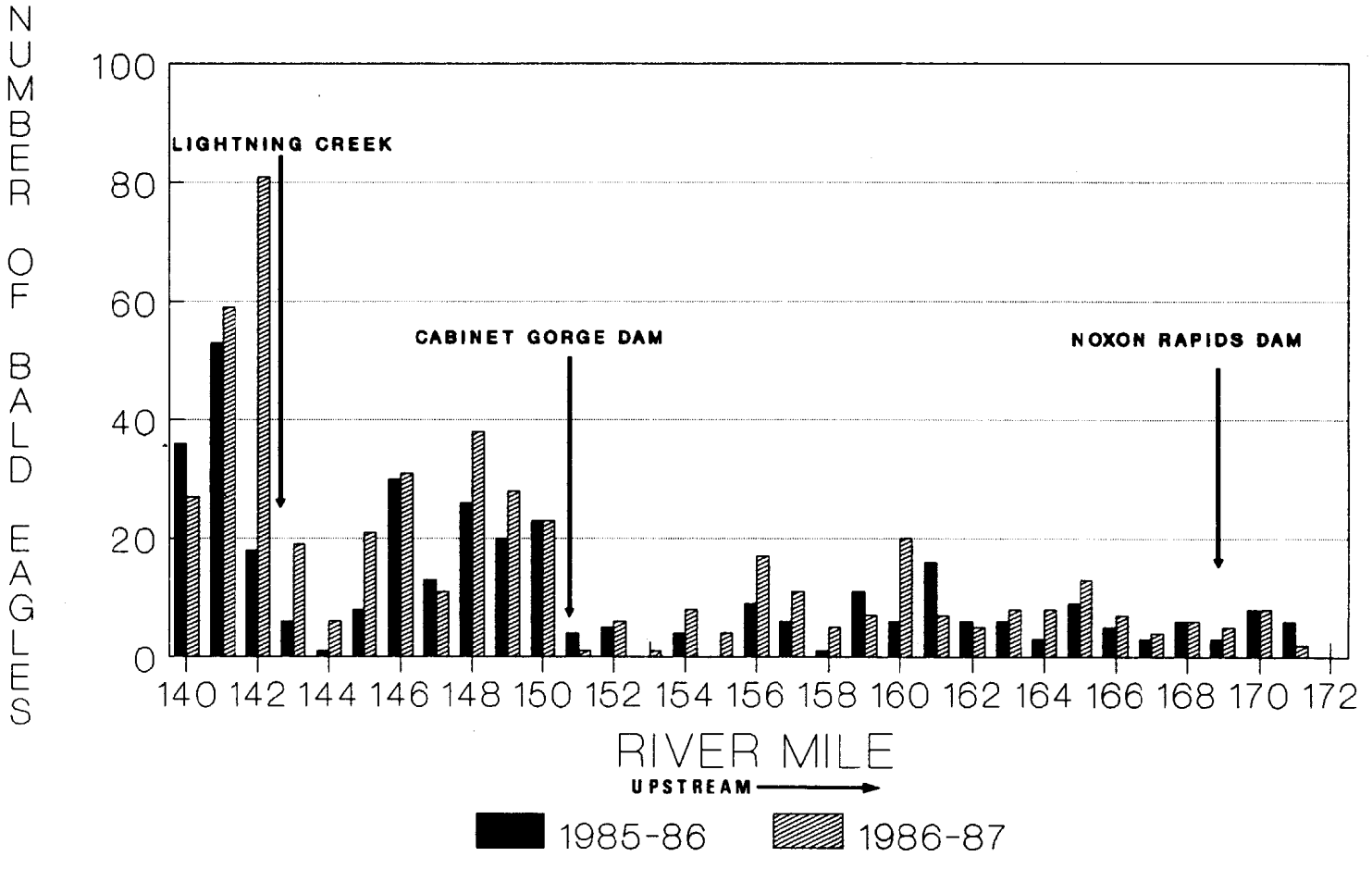


Figure 16. Distribution of total numbers of bald eagles in aerial censuses of the lower Clark Fork River, 1985-86 and 1986-87.

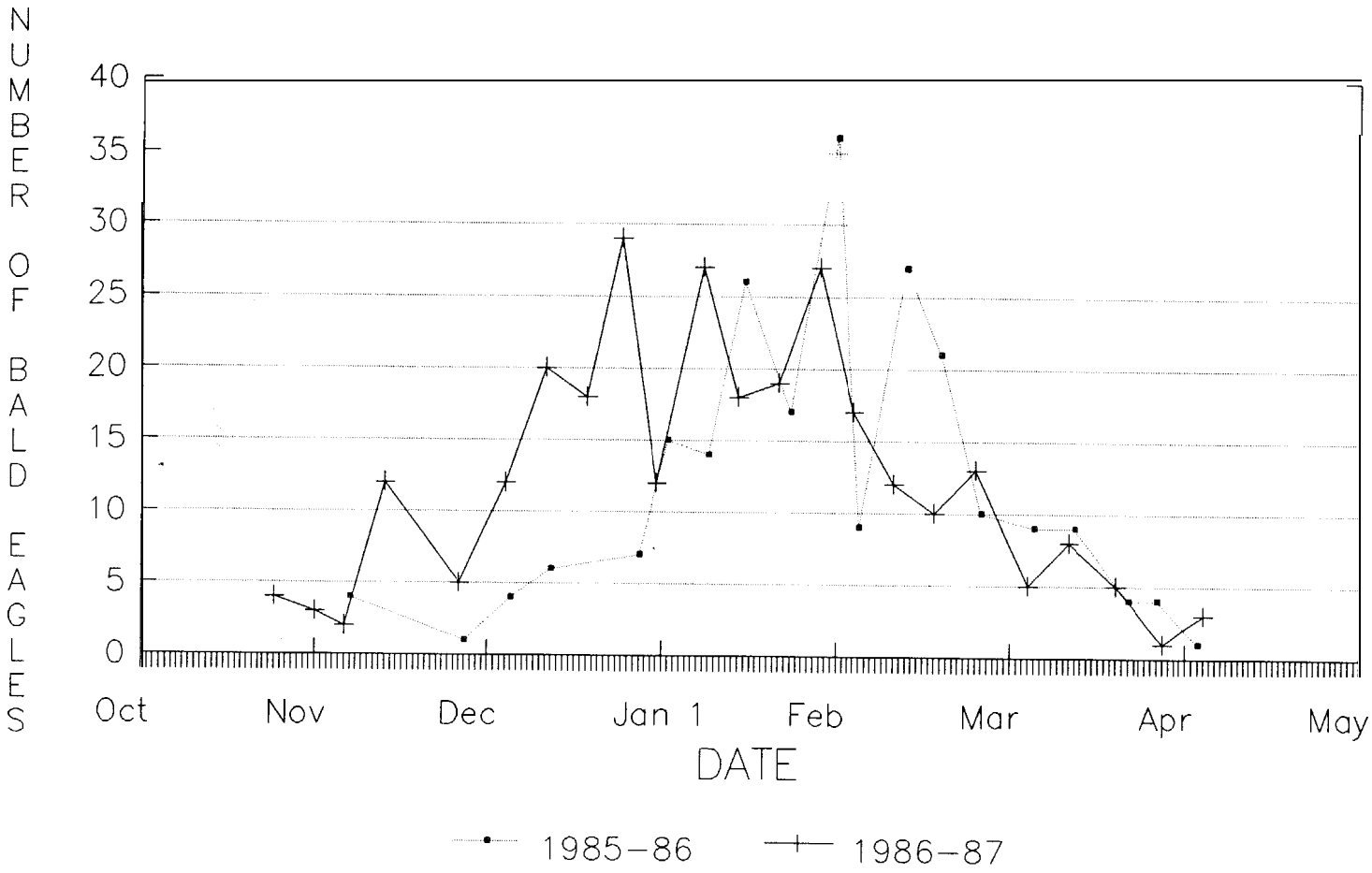


Figure 17. Numbers of bald eagles in aerial censuses of the upper Pend Oreille River, 1985-86 and 1986-87.

Distribution of bald eagles on the upper Pend Oreille River was similar during both concentration periods (Fig. 18); counts differed significantly ($P = 0.008$) only along RM 109. More open water and large numbers of waterfowl may have been responsible for the increase in eagle numbers on the river in 1986-87.

Monthly censuses of the lower Pend Oreille River from Smith Creek downstream to Albeni Falls Dam (N = 8) that were begun in February 1986 indicated low numbers of eagles in this area during most of the sample periods (Fig. 19).

CAPTURE AND MOVEMENTS OF BALD EAGLES

Six adult and two subadult bald eagles were captured, measured, and equipped with radio-transmitters during the 1985-86 concentration period (Table 4; Appendix C). Residencies within the study area after capture ranged from 1 to 35 days ($\bar{x} = 13.9$) in 1985-86. Residencies of four eagles that returned in 1986-87 ranged from 27 to 113 days ($\bar{x} = 58.3$). Eagle residencies were not strongly related to the date of the peak aerial census in 1985-86 or 1986-87 (Figs. 20 and 21). In 1986-87, two transmitter-equipped eagles arrived before the peak census; two arrived after the peak. In both years of the study, all transmitter-equipped eagles departed after the peak census. Departure dates of the four bald eagles that returned to the study area in 1986-87 occurred well after the peak census in 1985-86 ($\bar{x} = 61.0$ days) and 1986-87 ($\bar{x} = 66.5$ days).

Eagle #01

The first eagle equipped with a transmitter, #01, was an adult captured at Garfield Bay on Lake Pend Oreille at 0804 h on 23 January 1986 (Fig. 22). Subsequent monitoring revealed two days' movement north to Bottle Bay, then west along the upper Pend Oreille River near Smith Creek to the Muskrat Lake area where travel was more limited for the next 12 days. On 8 February, it flew northeast approximately 21 km, remaining in this location near the Pack River along Berry Creek until 10 February, the last day a telemetry signal was received. On 17 February and again on 2 March, eagle #01 was sighted with other eagles at Tule Lake National Wildlife Refuge, California, 15 km south of the Oregon border, a distance of approximately 1,185 km southwest of Lake Pend Oreille.

Eagle #02

Eagle #02, an adult, was captured on 29 January 1986 at 1132 h at Garfield Bay and remained near the bay for the next five days (Fig. 23). On 5 February, it flew to the Pend Oreille River, continuing its flight to the west the

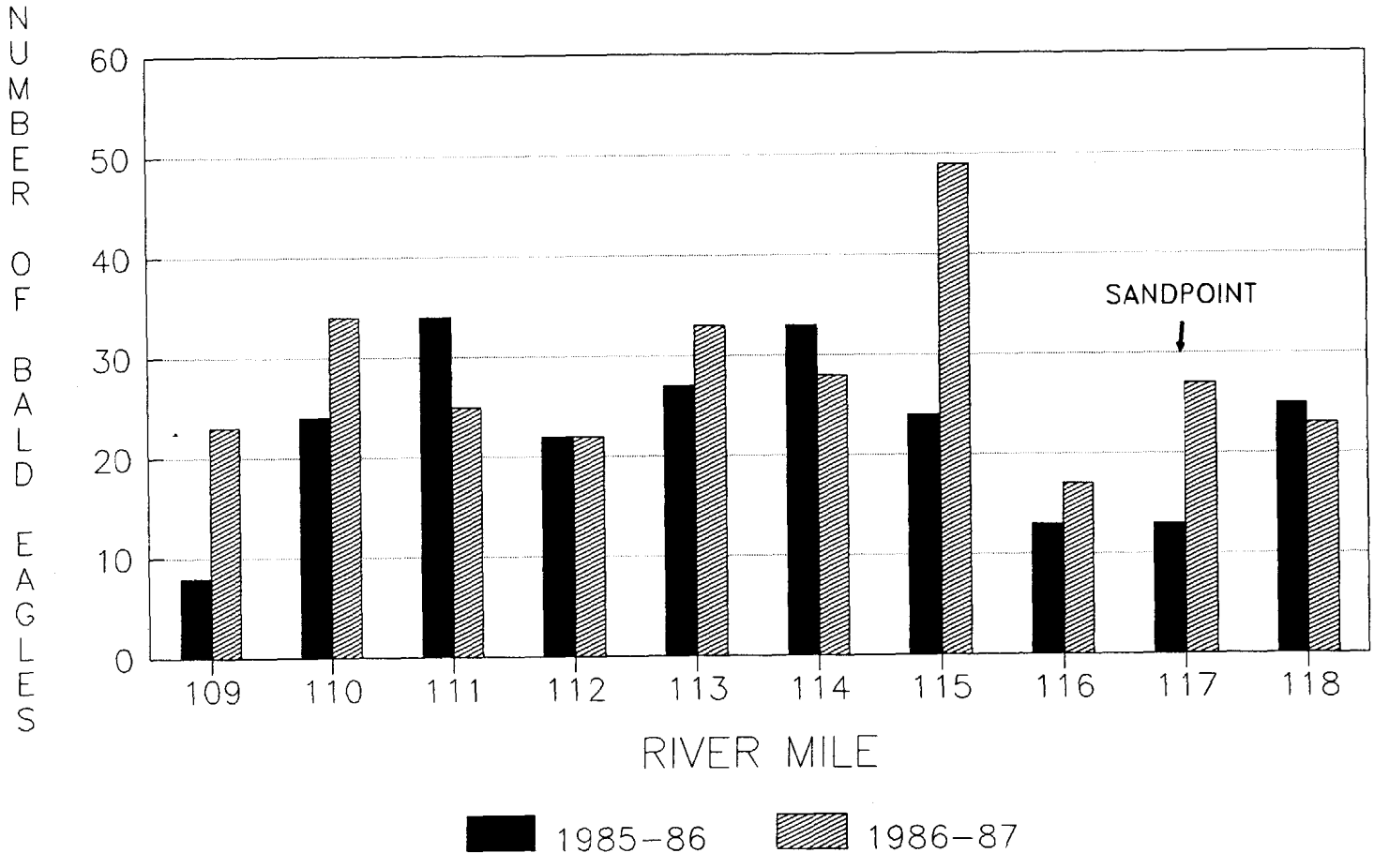


Figure 18. Distribution of total numbers of bald eagles in aerial censuses of the upper Pend Oreille River, 1985-86 and 1986-87.

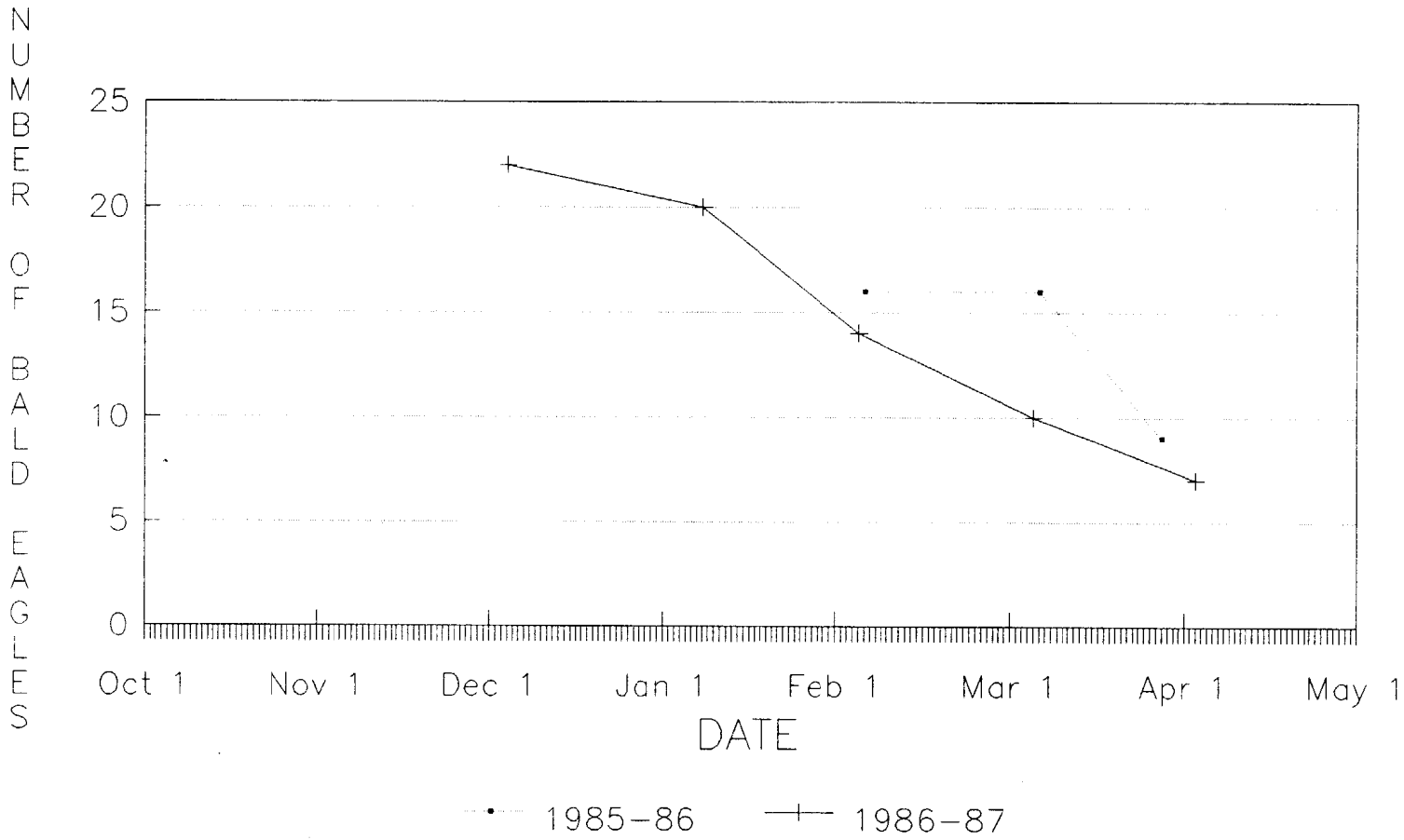


Figure 19. Numbers of bald eagles in aerial censuses of the Pend Oreille River from Smith Creek to Albeni Falls Dam, 1985-86 and 1986-87.

Table 4. Age classes, capture dates, and residencies of transmitter-equipped bald eagles on Lake Pend Oreille, 1985-86 and 1986-87.

Eagle ID#	Age class	1986 Capture date	Residency (days)	
			1985-86	1986-87
01	Adult	23 Jan.	19	--
02	Adult	29 Jan.	35	--
03	Adult	8 Feb.	19	113
04	Adult	17 Feb.	1	--
05	Adult	19 Feb.	3	27
06	Subadult	24 Feb.	23	53
07	Adult	11 Mar.	9	--
08	Subadult	4 Apr.	2	40

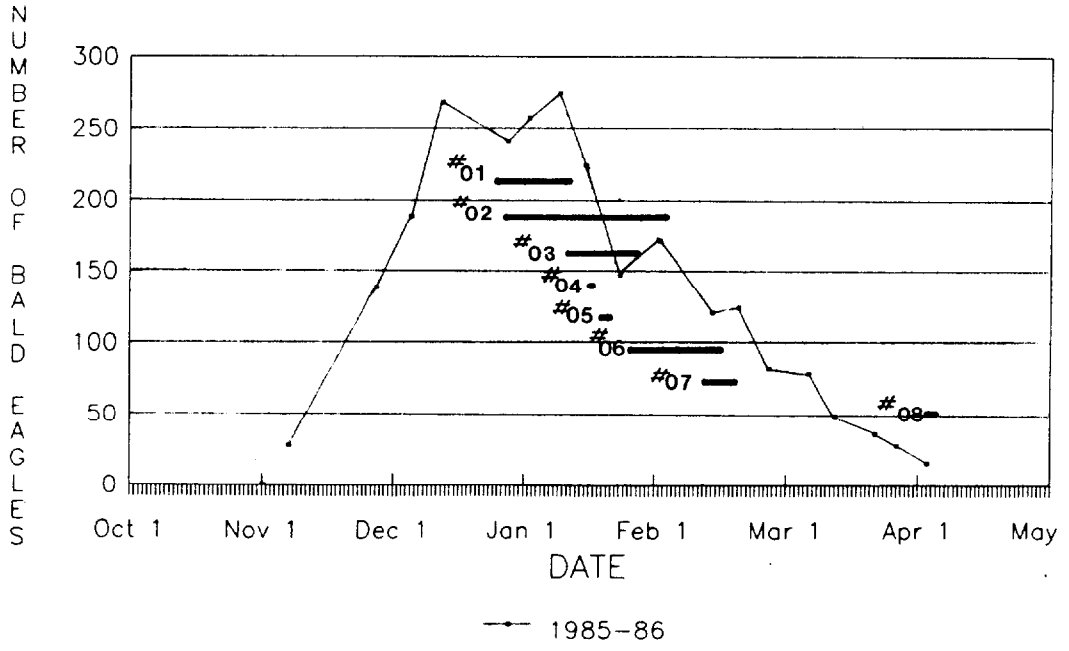


Figure 20. Numbers of bald eagles in aerial censuses and residencies of transmitter-equipped bald eagles, 1985-86.

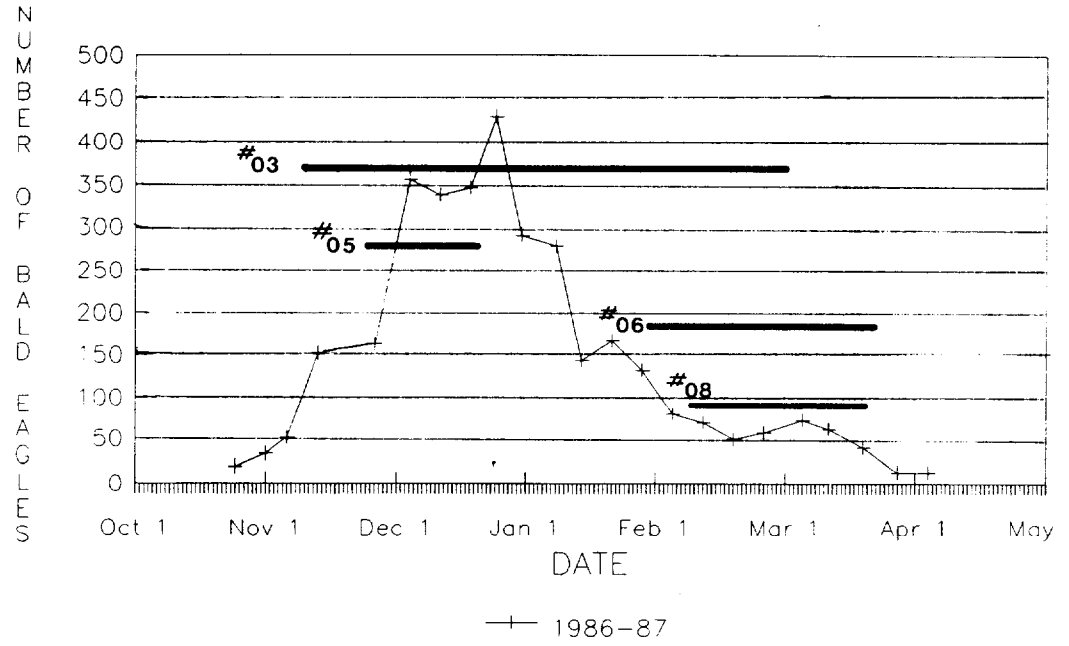


Figure 21. Numbers of bald eagles in aerial censuses and residencies of transmitter-equipped bald eagles, 1986-87.

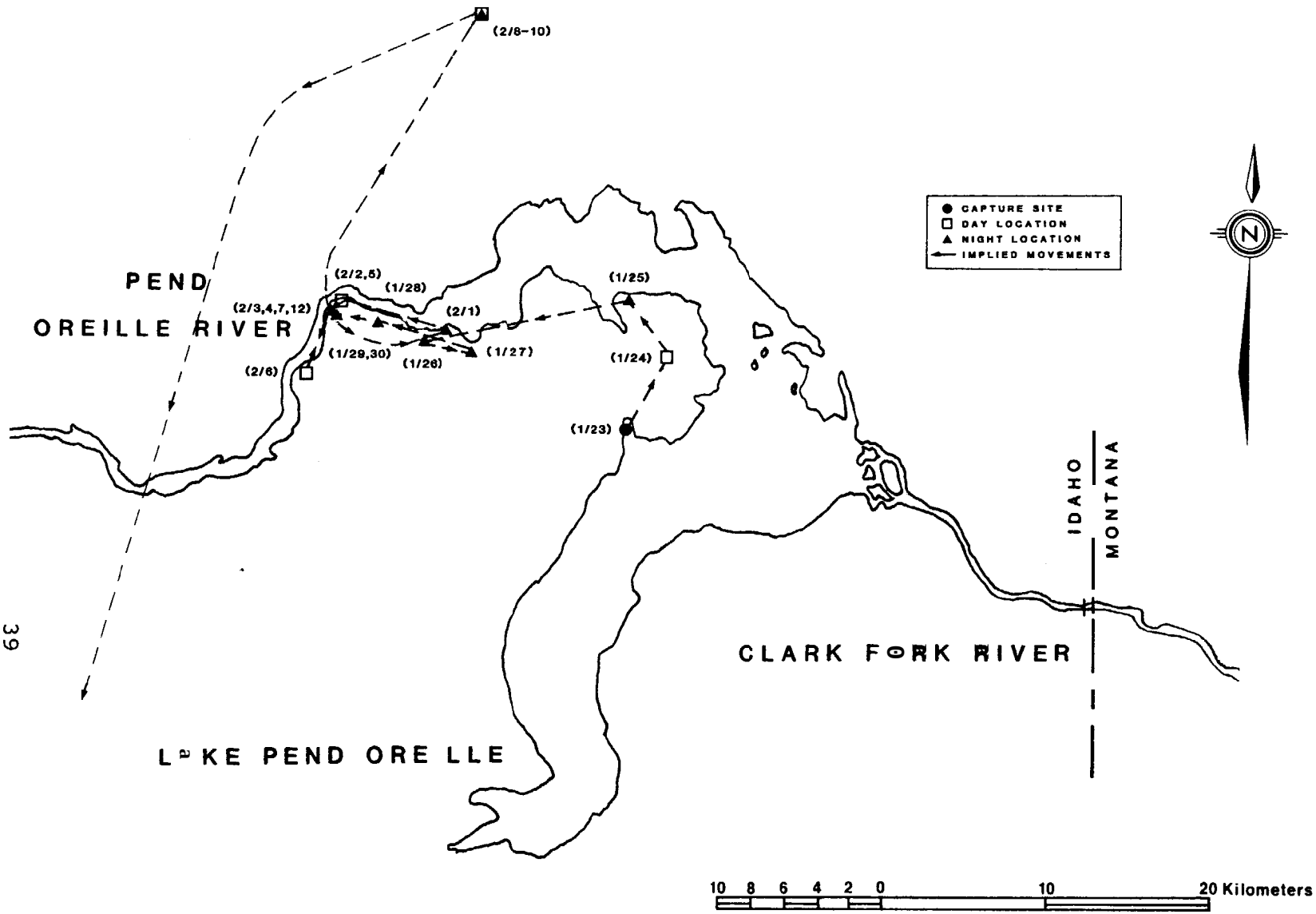


Figure 22. Movements of bald eagle #01, 1985-86.

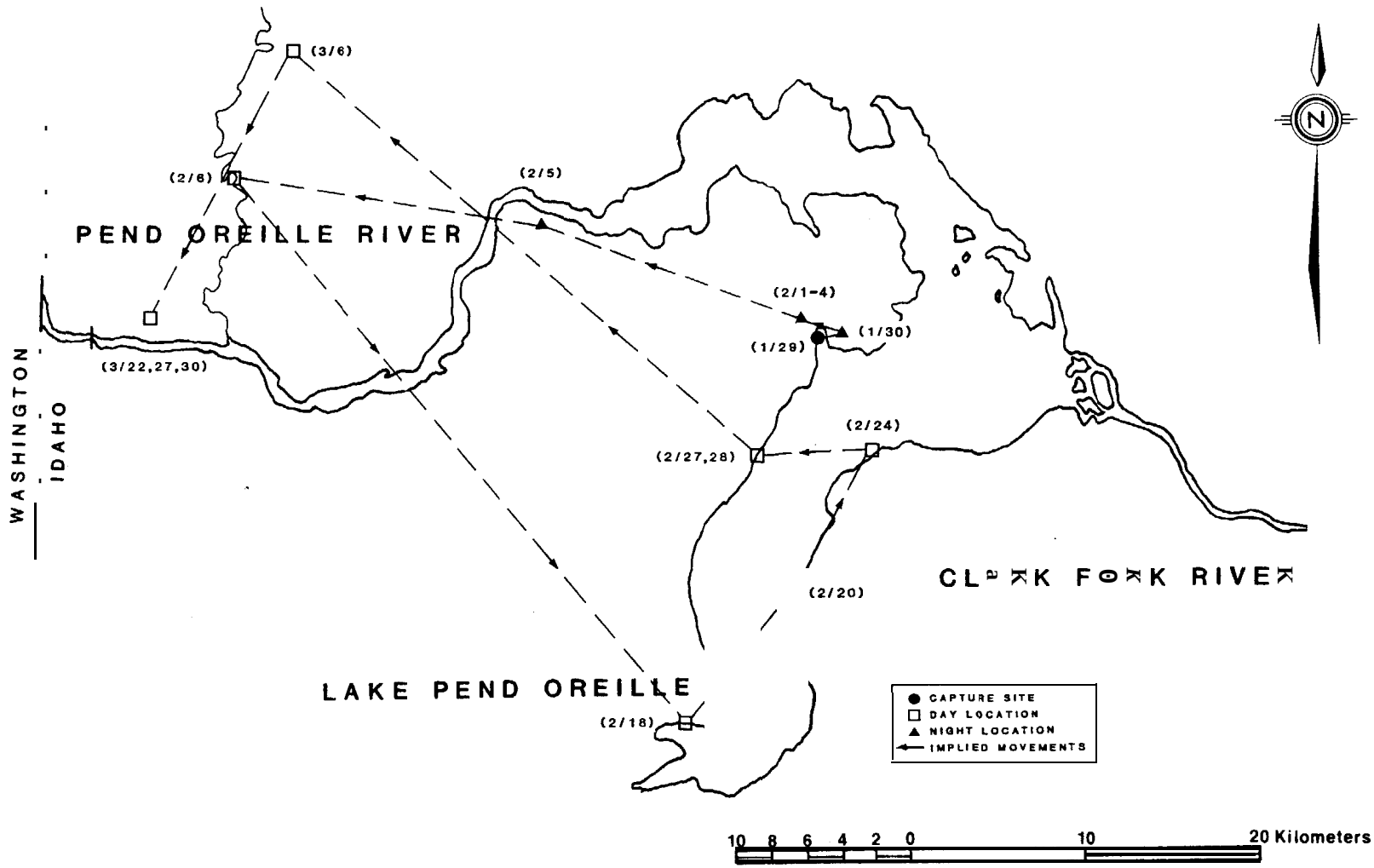


Figure 23. Movements of bald eagle #02, 1985-86.

following day to the Priest River where it was observed feeding on fish. Eagle #02 could not be located again until 18 February when it was found at the southern end of Lake Pend Oreille. It departed the southern half of the lake on 4 March and was observed on 6 March near the Priest River with an adult and a subadult bald eagle and several ravens (Corvus corax) feeding on a cow (Bovidae spp.) carcass. It was once again out of telemetry contact until 22 March when it was observed feeding on the carcass of a whitetail deer (Odocoileus virainianus) 3 km north of the Pend Oreille River. The eagle was located in the same area on two more occasions until departing the area after 30 March.

Eagle #03

Another adult eagle, #03, was captured at 1026 h on 8 February 1986 near the east shoreline of Garfield Bay (Fig. 24). It roosted the next two nights near the bay, but flew north on 10 February to roost west of Bottle Bay. Eagle #03 moved west to remain along the Pend Oreille River for the next four days, after which time it flew back to the lake near Garfield Bay. It was sighted far to the southeast on Cabinet Gorge Reservoir on 20 February, moved back downstream along the Clark Fork River during the next three days, and was last sighted during the winter of 1985-86 on 25 February flying to roost from Denton Slough on Lake Pend Oreille.

Eagle #03 returned to the lake on 9 November 1986 and roosted near the Clark Fork River delta (Fig. 25). It roosted to the north near Denton Slough the following evening and returned again to the delta one day later. On 12 November, it flew west to the Pend Oreille River south of Smith Creek where it remained for the next 2 weeks, until moving back to the lake 8 km south of Garfield Bay on 26 November. Eagle #03 was sighted next back at Denton Slough: it roosted and hunted in the vicinity until flying to Lightning Creek along the Clark Fork River on 2 December. It was observed the next ten days hunting and feeding on kokanee salmon on the creek and the river, and then flew to Granite Creek Bay on the lake. After two days, it moved to the southern end of the lake, remaining there from 15-18 December; approximately 150 eagles were in this area at this time feeding on salmon spawning along the shoreline and at the mouth of tributaries. On 31 December, eagle #03 was back at Denton Slough, then moved northwest near the Pack River delta, and finally back to the Clark Fork delta in early January. It remained in the vicinity of Denton Slough from 7-12 January.

Signals from eagle #03's transmitter were not received again for over two weeks from either ground or aerial monitoring. On 29 January, eagle #03 was sighted back at

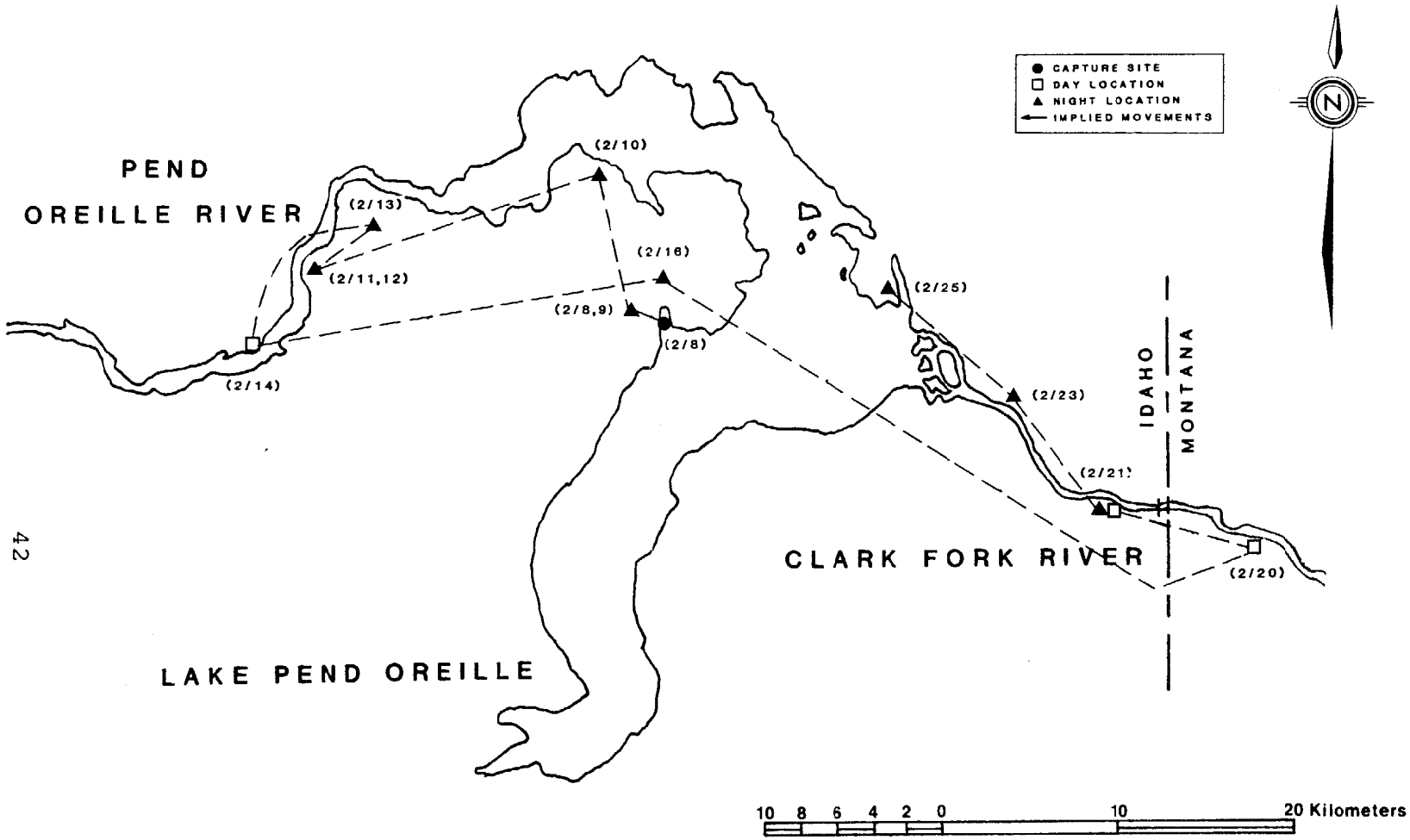


Figure 24. Movements of bald eagle #03, 1985-86.

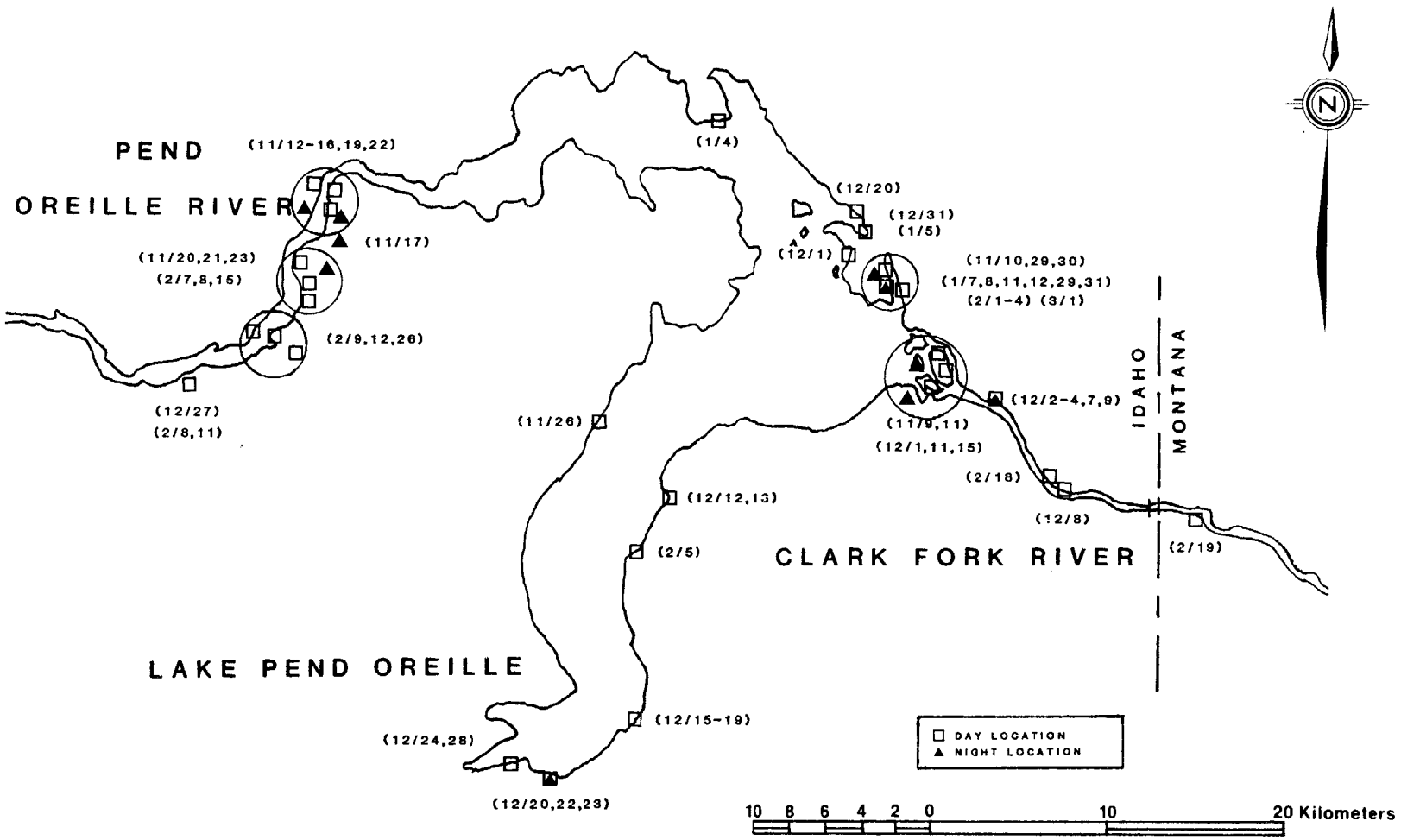


Figure 25. Movements of bald eagle #03, 1986-87.

Denton Slough during the weekly aerial census, and remained at this location for the next week. At Denton Slough, extensive shallows exist and, when warmer temperatures begin to melt the ice cover, live and dead winter-killed fish become more available. Eagle #03 left the slough for the southern part of the lake on 5 February, continued west stopping along the Pend Oreille River where it remained from 7-15 February. It returned to Denton Slough to roost the evening of 15 February, flew about 7 km up the Clark Fork River on 18 February, and flew above the Cabinet Gorge Dam about 14 km further upstream on the following day. It returned to the Pend Oreille River from 20-28 February and then flew to the Clark Fork River delta/Denton Slough area. Eagle #03 was once again out of telemetry contact for the first week of March. However, it was subsequently located along the Kootenai River near Troy, Montana, 14 km east of the Idaho border, approximately 45 km from its last location on Lake Pend Oreille. It was sighted on numerous days from early March until its departure in mid-April.

Eagle #04

An adult bald eagle, #04, was captured in Garfield Bay at 1012 h on 17 February 1986. After release, it flew to perch in a ponderosa pine (Pinus ponderosa) approximately 1 km west of the bay. No additional signals were received from eagle #04's transmitter later that evening or during subsequent monitoring sessions.

Eagle #05

Eagle #05, an adult, was captured at 0916 h on 19 February 1986 at Garfield Bay (Fig. 26). The eagle remained in the northern part of Lake Pend Oreille until 23 February when it flew south out of telemetry contact. From 10-20 March, #05 was observed perched in a grove of cottonwoods (Populus spp.), and with other eagles and ravens feeding on a whitetail deer carcass along the St. Joe River near Calder, Idaho, approximately 110 km south of its last known location on Lake Pend Oreille.

On 24 December 1986, eagle #05 was once again sighted in northern Idaho along the Pend Oreille River where it remained for the next three days. On 29 December, it moved onto northern Lake Pend Oreille near the Pack River Delta until 5 January when it flew to the Clark Fork River delta area. By 8 January, #05 moved to Granite Creek where it was observed feeding on spawning kokanee salmon with several other eagles. It remained in this area until 20 January when the signal from its transmitter could no longer be received.

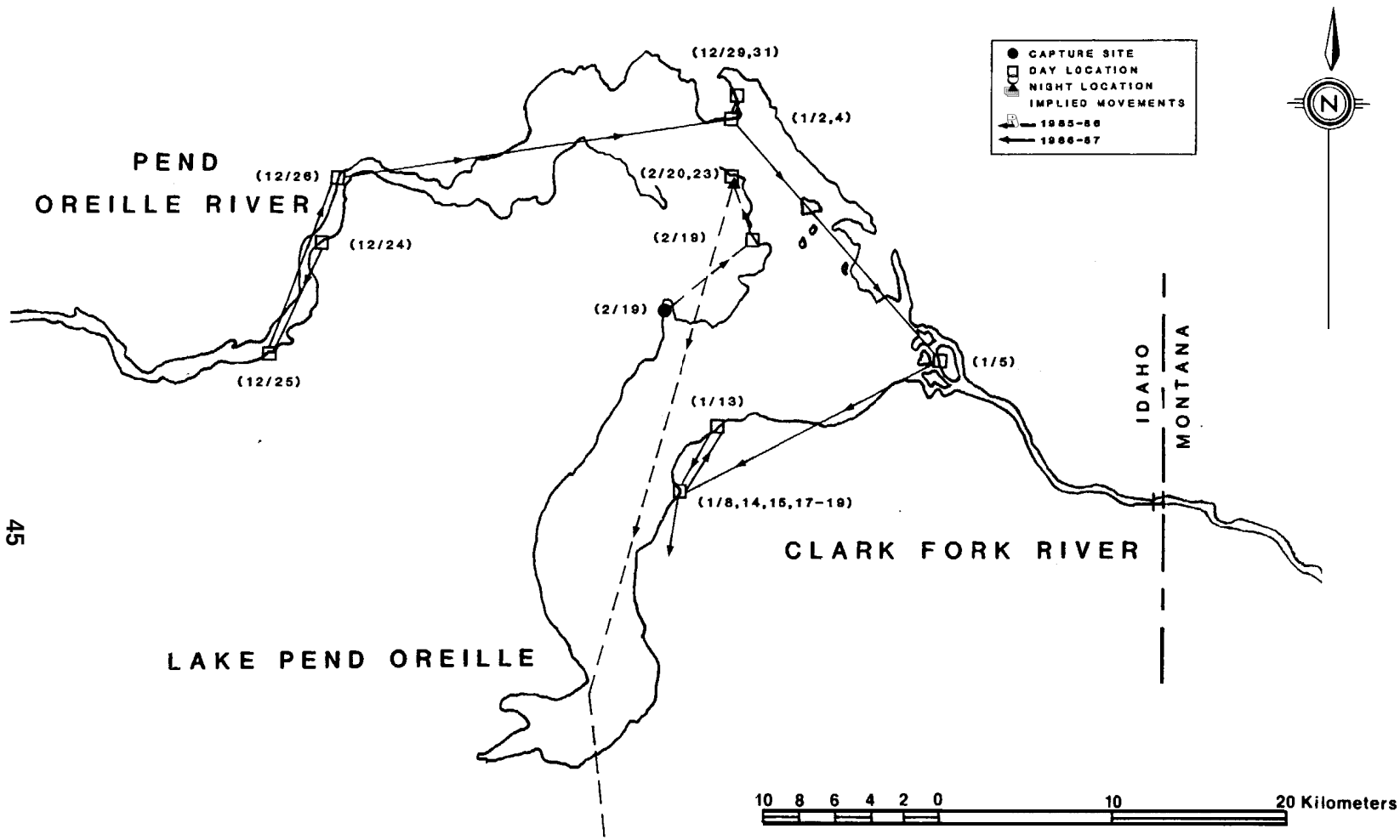


Figure 26. Movements of bald eagle #05, 1985-86 and 1986-87.

Eagle #06

Subadult eagle #06 was captured at 1045 h on 24 February 1986 along the west side of Garfield Bay (Fig. 27). It was located the following day to the northeast near the Pack River delta. It then moved to the Clark Fork River delta on 26 February and roosted in the Johnson Creek area. On 27 February, it was observed feeding on a whitetail deer carcass on the shore of the Clark Fork River and was located on subsequent days in this area through 8 March. By 12 March, eagle #06 had moved upstream along the river to the confluence with the Bull River, Montana, and then moved another 10 km onto Noxon Reservoir the next day where it was sighted perched on ice along the edge of open water above Noxon Rapids Dam. Five days later on 18 March, eagle #06 was back on Lake Pend Oreille along Denton Slough where it remained until leaving the study area in mid-afternoon on 22 March.

Eagle #06, in adult plumage, returned to Lake Pend Oreille along Denton Slough on 29 January 1987 (Fig. 28). Subsequent locations documented movements on the Clark Fork River and delta, and then back to Denton Slough on 18 February. On 23 February, eagle #06 moved approximately 70 km downstream along the Pend Oreille River to Indian Island, Washington. Five days later, the eagle had returned to Denton Slough where it remained feeding on fish for the next 23 days until it departed the area on 22 March.

Eagle #07

Adult bald eagle #07 was captured at 0917 h on 11 March 1986 offshore from Pearl Island (Fig. 29). It departed the lake about 1200 h two days later, flying approximately 25 km north into the Cabinet Mountains, where it resided at approximately 1200 m elevation for the next six days. The final telemetry signal from #07 was received at 0900 h on 19 March in the same area; no signal was received by 1400 h.

Eagle #08

Eagle #08, a subadult, was captured at 0837 h on 4 April 1986 north of Sunrise Bay and roosted that evening near the capture site (Fig. 30). It flew northwest out of the study area the following day: its transmitter signal was lost by early afternoon.

The first location of-eagle #08 in 1987 was along the Pend Oreille River on 8 February. Two days later, the eagle had moved east about 45 km to Lake Pend Oreille near the capture site of the previous year. By 15 February, it was sighted once again along the Pend Oreille River, this time just across the Washington/Idaho border. Eagle #08 could not be located for about three weeks until mid-March when it

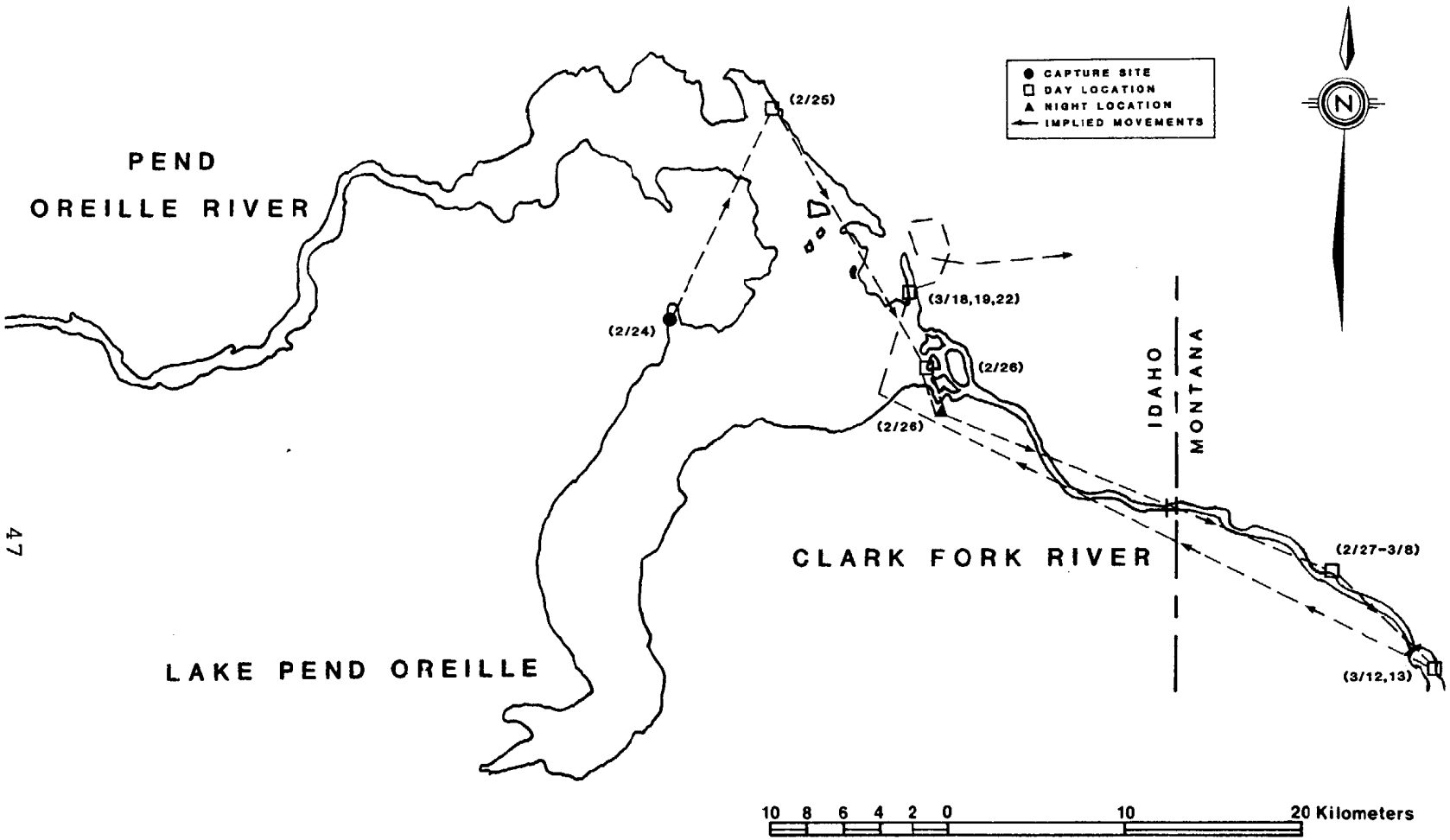


Figure 27. Movements of bald eagle #06, 1985-86.

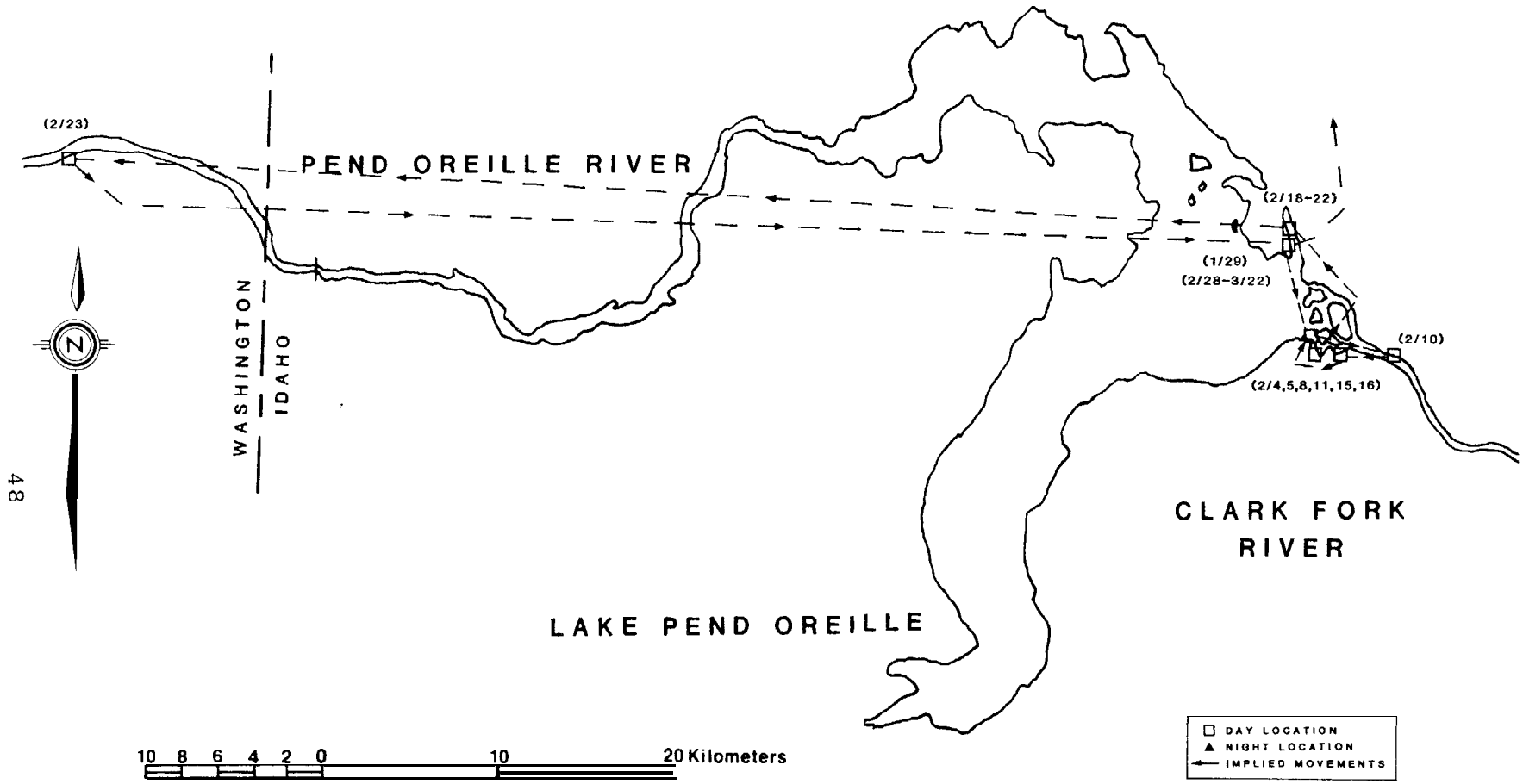


Figure 28. Movements of bald eagle #06, 1986-87.

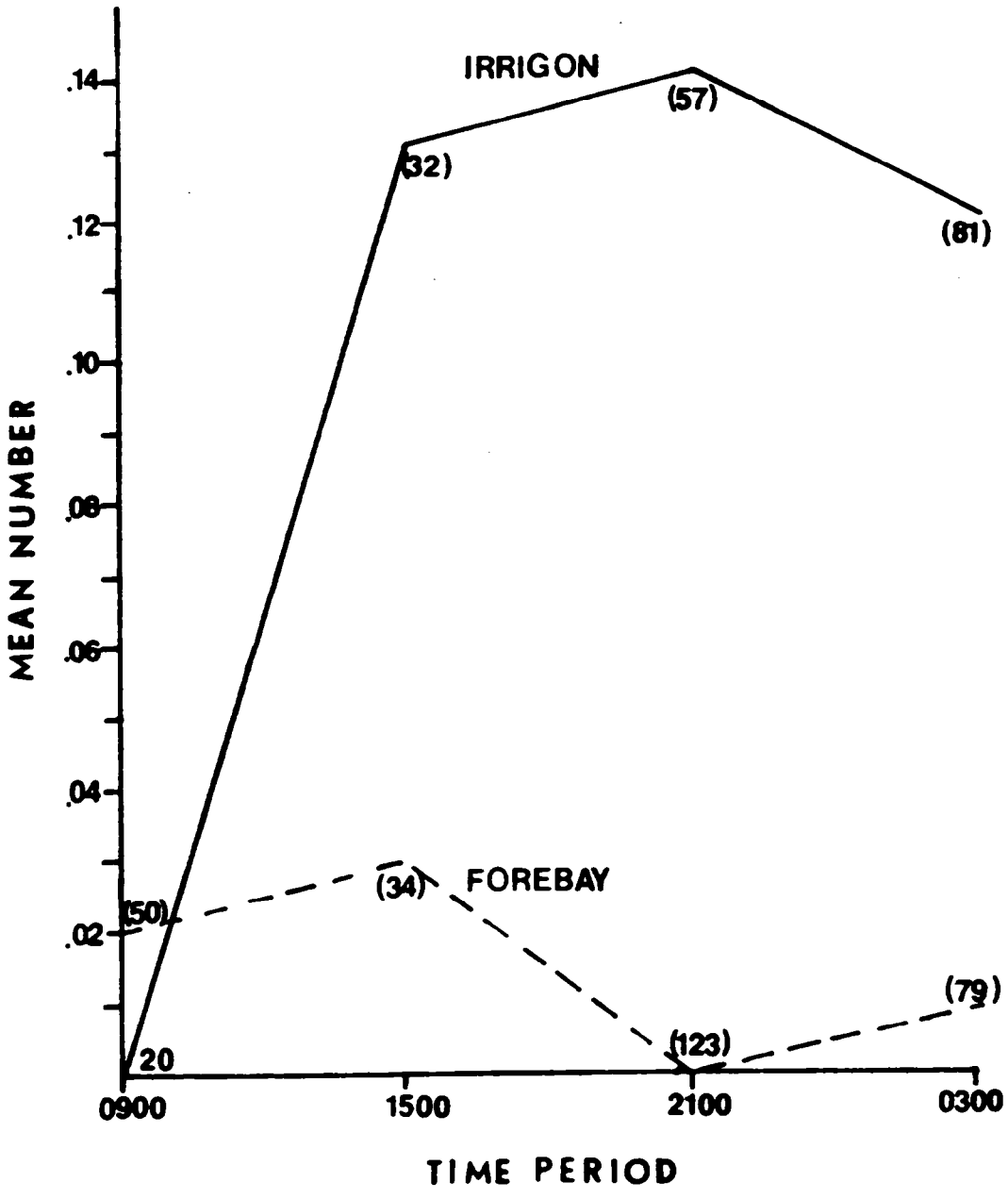


Figure 13. Mean number of juvenile salmonids consumed and time of capture for smallmouth bass collected at Irrigon and the John Day forebay, April to September 1982. Time periods are midpoints of six hour intervals. Sample sizes are in parentheses.

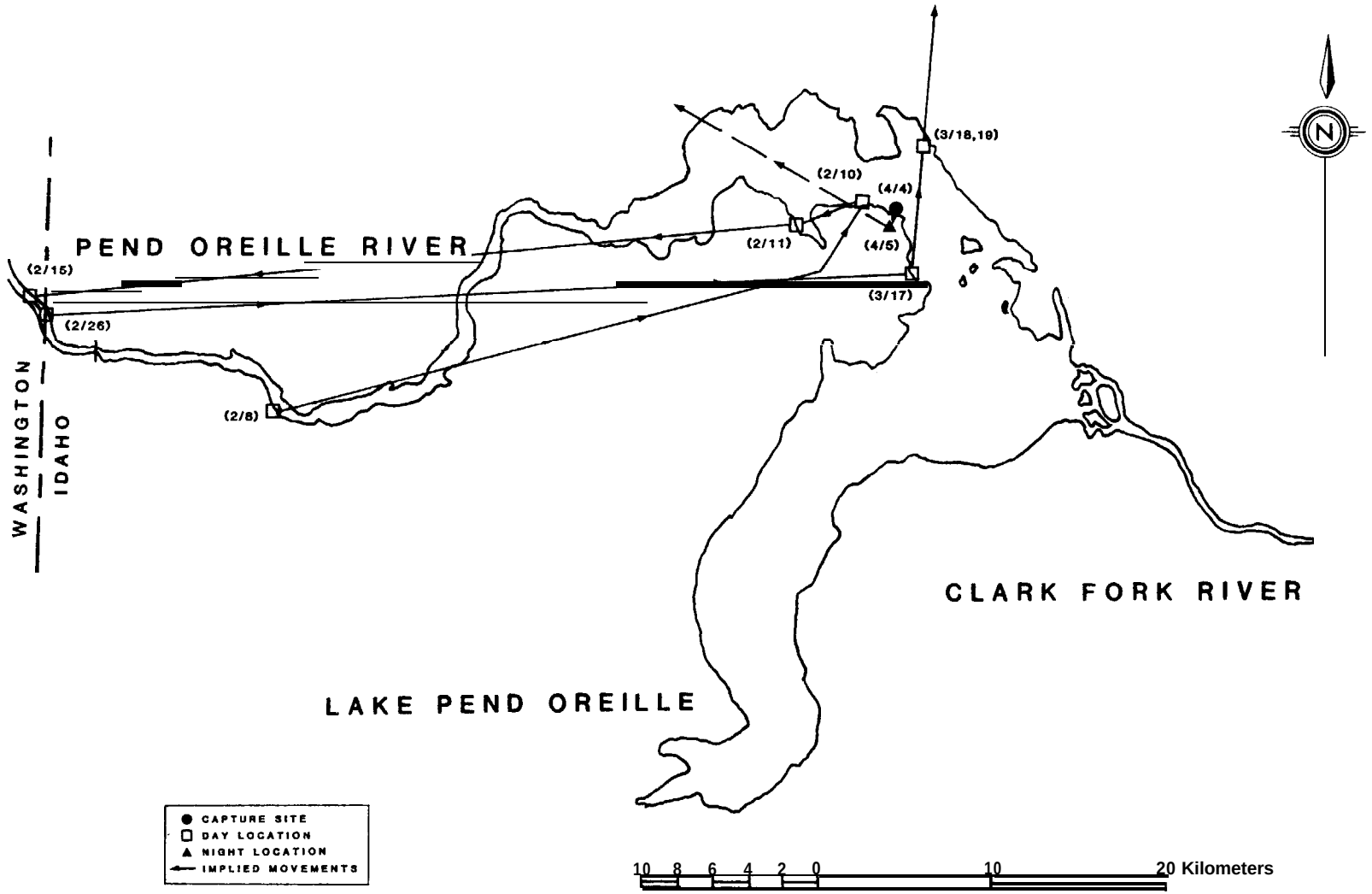


Figure 30. Movements of bald eagle #08, 1985-86 and 1986-87.

was observed on Lake Pend Oreille south of Sunrise Bay. It then spent two days along the Pack River delta before flying north out of the area on 19 March.

Interchange Of Easles With McDonald Creek Concentration

During the autumn of 1986, Glacier National Park, Montana, personnel at the McDonald Creek eagle concentration monitored for Lake Pend Oreille transmitter-equipped bald eagles. No transmitter signals were received nor were any green wing-markers observed during the concentration period (Oct.-Dec.).

Bald eagles equipped with wing-markers in Glacier National Park since 1977 (N > 100) were watched for during both years of the study on Lake Pend Oreille. Only one wing-marked eagle (A23) from the park was observed in the study area. The eagle was sighted along the south shore of the Pend Oreille River opposite Sandpoint on 27 January 1986, and approximately 16 km further downstream on 28 January: it was not seen in 1986-87. Eagle A23 was originally captured in the park as a juvenile on 18 November 1978 and has not been observed there during subsequent autumns: however, it was observed at Modoc National Wildlife Refuge in northeastern California on 15 January 1985 (McClelland, personal communication, 1985).

Known long-range movements of transmitter-equipped eagles at Lake Pend Oreille and Glacier National Park (Young 1983, McClelland et al. 1984, B. R. McClelland, personal communication, 1987) indicate little exchange of eagles migrating between the two locations. However, with the apparent collapse of the eagle concentration in the park in the autumn of 1987 resulting from extremely low salmon numbers (B. R. McClelland, personal communication, 1987), the possibility of a future increase in the number of eagles migrating into the Lake Pend Oreille area from the east seems more likely, particularly if alternative prey resources are not available.

NOCTURNAL ROOSTS

At night, wintering bald eagles have been observed roosting singly, in small groups, or communally in locations to which they may return on a regular basis (Shea 1973, Steenhof et al. 1980, Keister and Anthony 1983). In the Lake Pend Oreille area, many instance's of roosting by small numbers of eagles were documented and three major roosts were identified (Fig. 31). Fewer roost locations were obtained in southern Lake Pend Oreille due to its inaccessibility by automobile throughout most of the winter months. Two nocturnal roosts along the Pend Oreille River

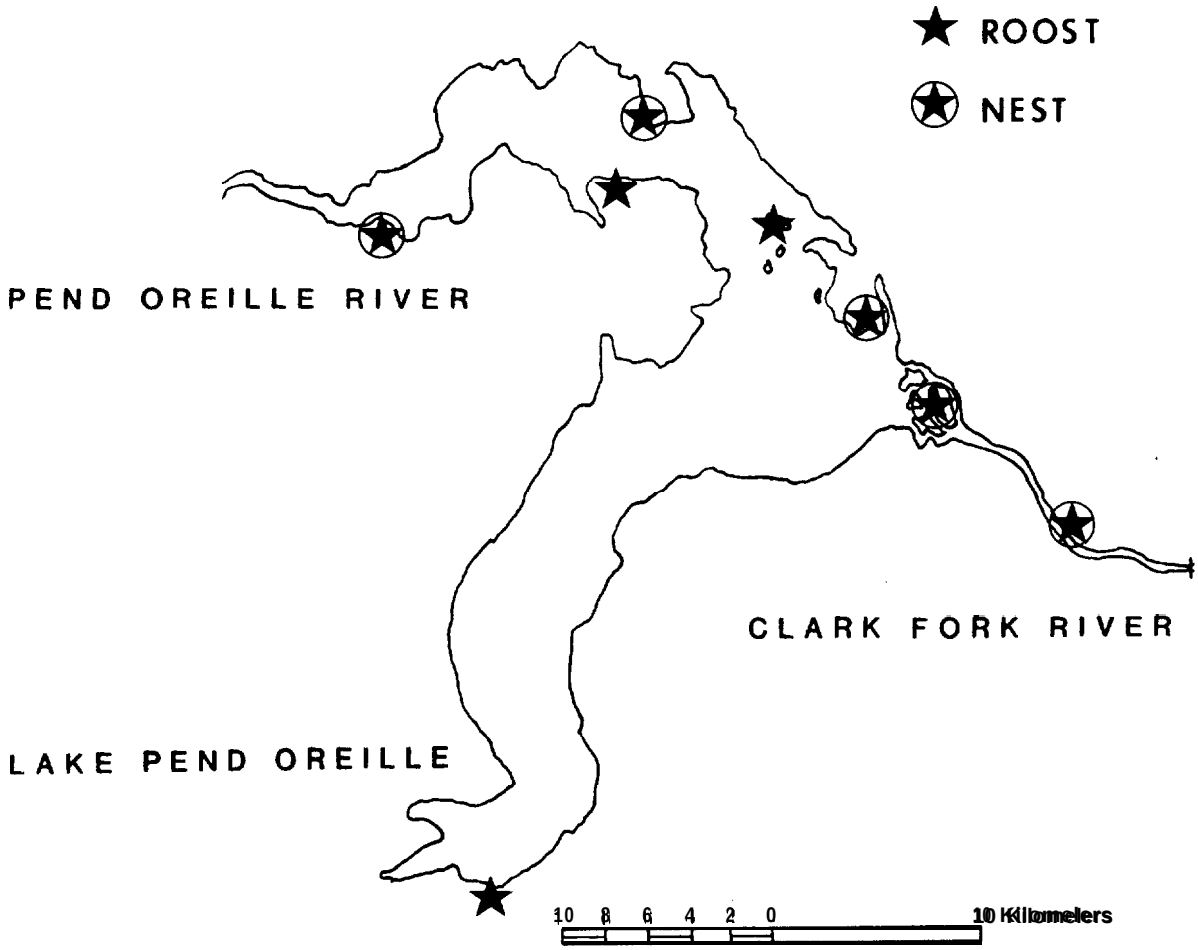


Figure 31. Map of major nocturnal roosts of bald eagles on Lake Pend Oreille and bald eaqle nests, 1985-86 and 1986-87.

identified by Meyer (1979) were used sporadically in 1985-86 and 1986-87 by relatively few eagles as were numerous other sites. The use of numerous roost sites dispersed throughout the study area may indicate the importance of eagles remaining near a plentiful, but shifting food source, and no lack of suitable roost trees.

Warren Island Roost

Warren Island Roost lies along a north-south ridgeline on the western side of this privately-owned island at a mean elevation of 2140 m and mean distance to the lake of approximately 122 m (SW 1/4, Sec. 34, T57N, R1E; NW 1/4, Sec. 3, T56N, R1E, Boise Meridian) (Appendix D-l). Several homesites exist at scattered locations near the shoreline of the island, but none are in use during the winter months when eagle use occurs.

Counts of eagles at the roost from early December to March revealed frequent use and high numbers of eagles present (maximum count: 49 [1985-86]; 32 [1986-87]), particularly during 1985-86 when more eagles remained in the northern parts of the lake (Tables 5 and 6).

Eight roost trees were identified during counts and reaffirmed by collection of pellets and prey remains at the tree bases (Table 7). Mean tree dbh was 61.9 cm; mean tree height was 29.4 m. Douglas-fir (Pseudotsusa menzeisii) and western larch (Larix occidentalis) were the most common roost tree species. Five of the roost trees were snags; two of these were blown down by high winds in the summer of 1987.

East Bottle Bay Roost

East Bottle Bay Roost lies on a north-facing slope on private and USFS land from approximately 215 m from the lakeshore at 2200 m, up-slope to just below the summit of a ridge at 2900 m (SW 1/4, SE 1/4, Sec. 27, and NE 1/4, Sec. 34, T57N, R1W, Boise Meridian) (Appendix D-2). A dirt road accesses summer homesites near the roost from its lower end, but is seldom-used during winter. Old, partially overgrown logging roads traverse the roost.

Bald eagles roosted at East Bottle Bay throughout the concentration periods of both years (Table 8); the peak count occurred in late November (46 eagles). Large fluctuations in roost count totals during periods of heavy use may be due to thermal conditions promoting soaring activity by eagles on count days; in several instances, groups of eagles were observed leaving nearby feeding locations at Bottle Bay, then flying beyond and above the roost at dark to land at other locations higher on the hillside. High numbers of eagles of unidentified age class

Table 5. Counts of bald eagles at Warren Island Roost, 1985-86.

Date	Time	Adults	Subadults	Unidentified	Total
3 Dec.	PM	15	19	3	37
4 Dec.	PM	0	0	42	42
5 Dec.	PM	0	0	35	35
6 Dec.	AM	0	0	27	27
7 Dec.	AM	0	0	23	23
8 Dec.	PM	27	10	0	37
9 Dec.	PM	0	0	49	49
11 Dec.	PM	0	0	43	43
13 Dec.	PM	0	0	39	39
14 Dec.	PM	0	0	33	33
15 Dec.	PM	0	0	30	30
16 Dec.	PM	0	0	34	34
17 Dec.	PM	0	0	24	24
18 Dec.	AM	0	0	27	27
20 Dec.	PM	0	0	24	24
24 Dec.	PM	0	0	8	8
25 Dec.	PM	5	6	0	11
17 Jan.	PM	17	6	0	23
21 Jan.	PM	10	3	0	13
24 Jan.	PM	8	7	0	15
26 Jan.	PM	3	0	8	11
28 Jan.	PM	6	10	0	16
31 Jan.	PM	9	7	7	23
6 Feb.	PM	2	5	0	7
7 Feb.	PM	4	2	2	8
11 Feb.	PM	5	2	0	7
14 Feb.	PM	6	2	0	8
18 Feb.	PM	1	0	0	1
21 Feb.	PM	2	1	0	3
25 Feb.	PM	3	3	0	6
28 Feb.	PM	2	3	0	5
4 Mar.	PM	1	1	0	2
8 Mar.	PM	0	0	0	0

Table 6. Counts of bald eagles at Warren Island Roost, 1986-87.

Date	Time	Adults	Subadults	Unidentified	Total
9 Dec.	PM	0	0	10	10
11 Dec.	PM	5	8	3	16
18 Dec.	PM	8	13	11	32
6 Jan.	PM	6	7	7	20
13 Jan.	PM	1	1	0	2
19 Jan.	PM	8	8	0	16
22 Jan.	PM	3	8	2	13
26 Jan.	PM	3	0	8	11
29 Jan.	PM	3	8	0	11
18 Feb.	PM	1	4	0	5
5 Mar.	PM	1	0	0	1

Table 7. Characteristics of eight roost trees at Warren Island Roost, 1987.

Tree no.	Aspect	Slope (degrees)	Tree dbh (cm)	Tree height (m)	Tree species	Tree condition
1	S-SW	10	105.5	44.9	Douglas-fir	Snag
2	S	6	67.0	31.5	Douglas-fir	Live: full crown
3	E-NE	5	38.8	25.2	Western larch	Snag
4	S-SW	2	39.6	24.1	Douglas-fir	Snag
5	S-SW	8	49.0	28.0	Western larch	Snag; down
6	N-NE	4	42.4	24.0	Western larch	Snag; down
7	S-SW	1	81.9	38.0	Black Cottonwood	Live: 1/2 crown
8	W	1	70.6	19.1	Douglas-fir	Live: broken top; osprey nest

Table 8. Counts of bald eagles at East Bottle Bay Roost, 1985-86 and 1986-87.

Date	Time	Adults	Subadults	Unidentified	Total
1985-86					
18 Nov.	PM	0	0	10	10
19 Nov.	PM	0	0	13	13
24 Nov.	PM	0	0	46	46
26 Nov.	AM	2	0	6	8
26 Nov.	PM	22	8	2	32
30 Nov.	PM	1	0	5	6
8 Dec.	PM	1	0	0	1
26 Dec.	PM	2	1	17	20
14 Jan:	PM	11	2	0	13
17 Feb.	PM	15	4	4	23
26 Mar.	PM	0	0	0	0
1986-87					
10 Dec.	PM	12	12	0	24
23 Dec.	PM	3	0	0	3
4 Feb.	PM	2	2	0	4

and some of the variability in roost count totals resulted from the extreme distances from observers to the roost, and the presence of weather conditions (sun glare, fog, low clouds, precipitation) preventing more accurate results. Total counts of roosting eagles at this and other roosts were believed to be conservative due to these factors and the inability to observe all roost trees from count locations.

Use of ten roost trees at East Bottle Bay was identified visually and confirmed later by the presence of numerous pellets and prey remains at the bases of the trees (Table 9). Four trees were measured: mean dbh was 65.5 cm; mean height was 41.8 m. All of these trees were dead western larch. Eagles at this roost probably also use live trees, but due to the break-up and scattering of pellets as they fall and hit branches, and the difficulty in locating them from the ground, these trees were not adequately represented in the sample of trees measured.

Echo Bay Roost

Echo Bay Roost lies at the south end of Lake Pend Oreille on a north-facing slope of USFS land at a mean elevation of 2400 m and a mean distance to the lake of 120 m (NE 1/4, Sec. 13, T53N, R2W, Boise Meridian) (Appendix D-3). No development has occurred near the roost; though it is exposed to disturbance by boat traffic on the lake, minimal human activity occurs during winter.

The inaccessibility of the roost and inclement weather conditions which often prevailed in this area in winter prevented systematic counts of roosting eagles. On 23 December 1986, 33 bald eagles (30 adults, 3 subadults) were counted in the roost; this count was coincident with peak eagle numbers in the study area in 1986-87 and with peak counts of eagles in the southern part of the lake feeding on kokanee salmon.

BALD EAGLE NESTS

Three active bald eagle nests within the study area had been identified prior to this study; two additional nests were located in the winter of 1985-86 (Fig. 31). Incubation by adults began in late February or March both years at the four active nests (Table 10). A mean of one fledgling/nest at known productive sites was produced in 1986; a mean of 1.6 fledglings/nest was produced in 1987. The nesting pair of eagles at the Colby site apparently established an alternate nest site in 1987 and may have also used the same site in 1986; the new nest location has not been determined.

Table 9. Characteristics of four roost trees at Warren Island Roost, 1987.

Tree no.	Aspect	Slope (degrees)	Tree dbh (cm)	Tree height (m)	Tree species	Tree condition
1	N-NE	27	69.5	42.6	Western larch	Snag
2	N	29	63.5	38.9	Western larch	Snag
3	N	30	66.1	39.°	Western larch	Snag
4	N	34	64.0	46.8	Western larch	Snag; broken top

Table 10. Bald eagle incubation dates, nest productivity, and land ownership on Lake Pend Oreille, the lower Clark Fork River, and the upper Pend Oreille River, 1986 and 1987.

Nest location	Date incubation initiated		No. young fledged		Land ownership
	1986	1987	1986	1987	
Fisherman Island	22 Mar.	20 Mar.	2	2	Federal
Sheepherder Point	27 Feb.	5 Mar.	unknown	1	Private
Clark Fork River Delta	6 Mar.	5 Mar.	1	1	Private
Colby	inactive	inactive	0	0*	Private
Springy Point	22 Mar.	12 Mar.	0	2	Private

*Two young fledged at alternate nest.

HABITAT DESCRIPTION

Lake Pend Oreille

The most common habitat types within the 21 units of the shoreline zone (100 m width) on Lake Pend Oreille were western redcedar (Thuja plicata)/queencup beadlily (Clintonia uniflora) and Douglas-fir/ninebark (Physocarpus malvaceus) (Table 11). A mean of 44% of each unit was unforested: a mean of 17% was forested with old-growth and 34% with mature trees. Mean height of upper canopy trees was 23.2 m; mean density was 3.1 trees/ha. The northern half of the lake (units 11-12, 15-23) had gentler terrain and fewer steep slopes than the southern half of the lake (units 1–10). A mean of 63.5% of each northern unit was under private ownership; the USFS owned the majority of each southern unit ($\bar{x}$ = 98%) (Fig. 32).

The upland units surrounding the lake were classified into primarily the same habitat types as the shoreline units (Table 12). A smaller percentage of each unit was unforested ($\bar{x}$ = 38%): old-growth and mature trees comprised more of each unit ($\bar{x}$ = 45%). Mean upper canopy tree height ($\bar{x}$ = 22.6 m) and mean density ($\bar{x}$ = 4.7 trees/ha) were greater than found near the shoreline. Northern units had a variety of slopes, and were dominated by private ownership ($\bar{x}$ = 84%). All southern units had some slopes exceeding 60%; most land was owned by the USFS ($\bar{x}$ = 66%) and was managed primarily as natural areas.

Clark Fork River

The shoreline zone bordering the lower Clark Fork River from the delta upstream to Cabinet Gorge Dam (units 24 and 25) was of the western redcedar/queencup beadlily habitat type. Half of each unit was unforested (50%); old-growth and mature trees averaged 45% of each unit. Height of upper canopy trees ($\bar{x}$ = 23.9 m) was similar to lakeshore units: tree density was greater ($\bar{x}$ = 4.1 trees/ha). Slopes were relatively gentle. Land ownership was private.

In the upland zone, habitat types were similar to those found in the shoreline units. A mean of 50% of each unit was unforested; a mean of 40% of each unit was covered with old-growth and mature trees. Upper canopy trees were shorter ($\bar{x}$ = 21.4 m) and of higher densities ($\bar{x}$ = 8.6 trees/ha) than in adjacent shoreline units. Slopes increased dramatically with elevation. A mean of 80% of each unit was owned privately.

Pend Oreille River

The most common habitat type in the shoreline zone along the upper Pend Oreille River (units 13 and 14) was the western redcedar/queencup beadlily type. Unforested areas

Table 11. Habitat description of Lake Pend Oreille shoreline zones (100 m width).

Habitat unit	Habitat type[1]	Unforested land (%)	Forested land			Upper canopy trees		Most common slopes			
			% old-growth	% mature	% other	$\bar{x}$ height (m)	$\bar{x}$ trees/ha	10-30%	30-60%	>60%	cliffs
1	THPL/CLUN	30	25	45	0	26.2	3.6	-	-	X	X
2	THPL/CLUN; PSME/PHMA	60	15	15	10	22.0	3.6	-	-	X	X
3	PSME/PHMA	40	10	50	0	22.7	4.6		-	X	X
4	PSME/PHMA	65	10	25	0	27.3	4.1		-	X	X
5	PSME/PHMA	55	10	25	10	24.8	2.7	-	-	X	X
6	THPL/CLUN	35	20	45	0	21.2	4.9	-	-	X	X
7	THPL/CLUN	10	30	30	30	28.8	4.6	X	-		
8	PSME/PHMA	50	20	30	0	24.6	4.1	X	-	X	X
9	PSME/PHMA	40	20	40	0	20.8	4.6	-	-	X	X
10	PSME/PHMA; THPL/CLUN	60	10	20	10	23.6	2.6	-	-	X	X
11	PSME/PHMA	55	15	20	10	24.2	2.4	-	-	X	X
12	THPL/CLUN	25	25	35	10	24.8	2.3	-	X	X	
13	THPL/CLUN	30	10	35	15	23.0	2.6	X	-		
14	--	80	5	5	10	17.7	1.5	X	-		
15	PSME/PHMA; THPL/CLUN	30	15	45	10	19.3	2.2	X	-		
16	THPL/CLUN	20	20	60	0	25.4	2.2	X	-	X	
17	PSME/PHMA; THPL/CLUN	35	15	45	5	23.5	2.6	X	-	X	
18	PSME/PHMA; THPL/CLUN	40	20	35	5	21.5	1.7	-	X	X	
19	PSME/PHMA	65	15	20	0	20.9	1.9		X	X	X
20	PSME/PHMA	45	10	45	0	23.1	2.2	X	X		X
21	PSME/PHMA; ABGR/CLUN	40	30	30	0	21.2	2.8	X	X		
22	PSME/PHMA; THPL/CLUN	40	20	40	0	19.3	3.6	-	X	X	
23	PSME/PHMA	65	15	20	0	21.2	2.0	X	-	X	X
24	THPL/CLUN; SWAMP	40	10	40	10	25.0	5.1	X	-		
25	THPL/CLUN	60	20	20	0	22.7	3.0	X	-		

[1]Habitat type abbreviations:
THPL/CLUN: Thuja plicata/Clintonia uniflora (Western redcedar/Queencup beadlily)
PSME/PHMA: Pseudotsuga menzeisii/Physocarpus malvaceus (Douglas-fir/Ninebark)
ABGR/CLUN: Abies grandis/Clintonia uniflora (Grand fir/Queencup beadlily)

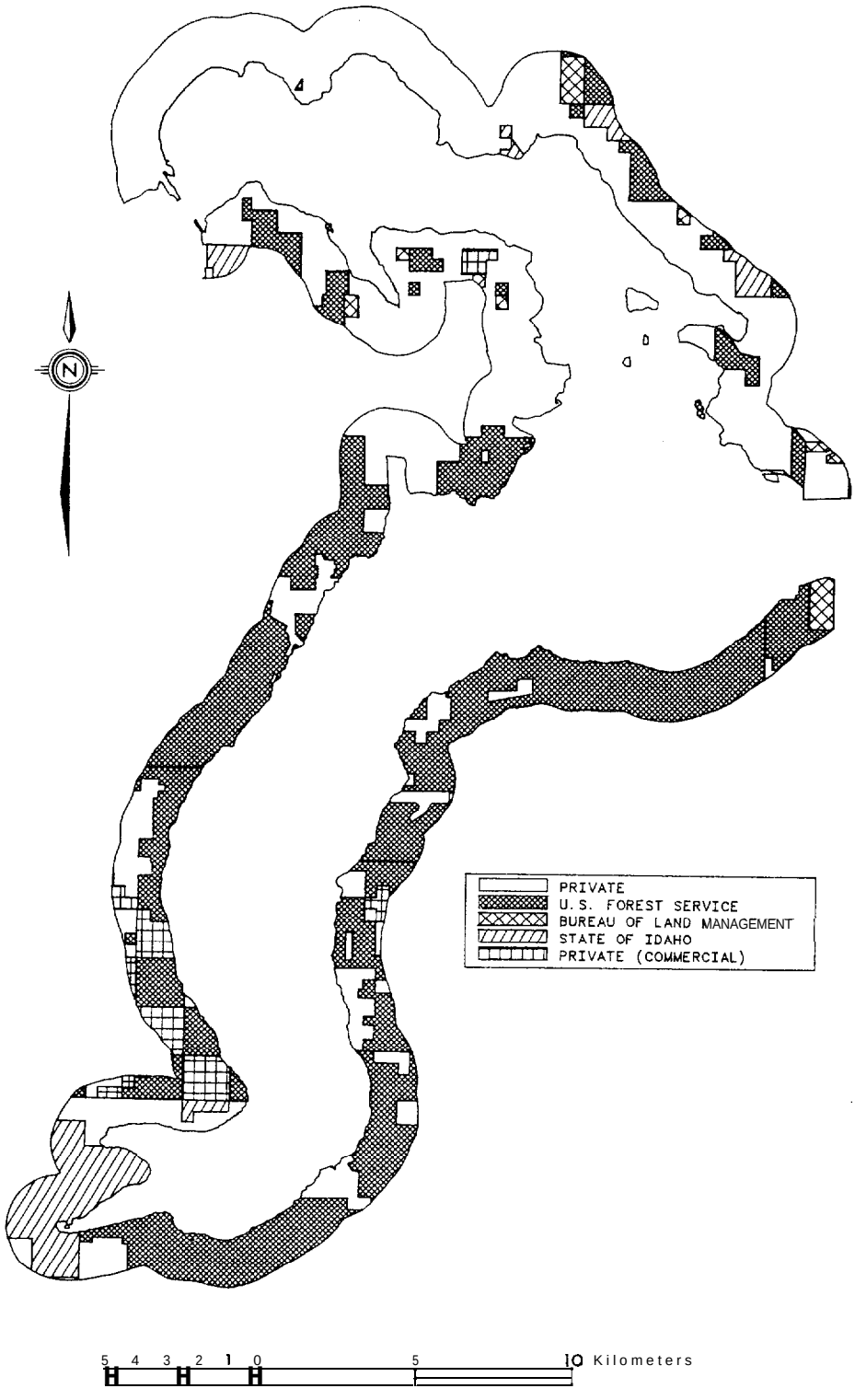


Figure 32. Map of land ownership surrounding Lake Fend Oreille.

Table 12. Habitat description of Lake Pend Oreille upland zones (1.6 km width).

Habitat unit	Habitat type[1]	Unforested land (%)	Forested land			Upper canopy trees		Most common slopes			
			% old-growth	% mature	% other	$\bar{x}$ height (m)	$\bar{x}$ trees/ha	10-30%	30-60%	>60%	cliffs
1	THPL/CLUN	15	20	60	5	28.0	5.1		-	X	x
2	PSME/PHMA; THPL/CLUN	40	20	25	15	25.7	3.3	-	-	X	x
3	PSME/PHMA THPL/CLUN	25	15	40	20	21.2	11.1	-	X		x
4	THPL/CLUN	35	5	15	45	19.7	8.1	X	-	X	
5	THPL/CLUN; PSME/PHMA	30	10	10	50	15.9	8.5	X	X	X	x
6	THPL/CLUN	30	20	50	0	26.7	5.7	-	-	X	x
7	THPL/CLUN	40	20	20	20	29.5	5.6	X	-		
8	PSME/PHMA	30	20	40	10	25.8	4.1	X	X	X	x
9	PSME/PHMA ABGR/CLUN	30	20	40	10	23.9	7.1	-	-	X	x
10	PSME/PHMA THPL/CLUN	40	10	30	20	24.6	7.5	-	-	X	x
11	THPL/CLUN PSME/PHMA	35	0	20	45	21.2	6.6	-	-	X	x
12	TSHE/CLUN THPL/CLUN	35	20	25	20	23.1	2.0	X	-	X	x
13	THPL/CLUN	60	15	25	20	24.5	2.6	X	-	X	
14	PSME/PHMA ABGR/CLUN	65	5	10	25	21.2	2.1	X	-		
15	THPL/CLUN	80	5	5	10	23.1	2.0	X	-		
16	PSME/PHMA	50	15	20	15	22.7	2.1	X	-		
17	PSME/PHMA ABGR/CLUN	30	20	40	10	23.1	2.8	X	-	X	
18	PSME/PHMA THPL/CLUN	35	10	25	30	19.7	0.8	-	X	X	
19	PSME/PHMA	40	20	40	0	21.6	1.6		-	X	x
20	PSME/PHMA THPL/CLUN	25	25	50	0	19.7	2.6	X	X		
21	THPL/CLUN	40	10	40	10	20.8	3.2	X	X		
22	PSME/PHMA THPL/CLUN	30	20	10	40	17.7	6.1		X	X	
23	THPL/CLUN	30	10	25	35	22.7	3.6		-	X	x
24	THPL/CLUN SWAMP	40	10	40	10	23.4	5.1	X	-		
25	PSME/PHMA THPL/CLUN	50	15	15	20	19.3	3.5	X	-	X	x

[1]Habitat type abbreviations: THPL/CLUN: Thuja plicata/Clintonia uniflora (Western redcedar/Queencup beadlily)
PSME/PHMA: Pseudotsuga menzeisii/Physocarpus malvaceus (Douglas-fir/Ninebark)
ABGR/CLUN: Abies grandis/Clintonia uniflora (Grand fir/Queencup beadlily)
TSHE/CLUN: Tsuga heterophylla/Clintonia uniflora (Western hemlock/Queencup beadlily)

within each unit averaged 55%; forested areas with old-growth and mature trees averaged 28%. Trees were shorter ($\bar{x}$ = 20.4 m) and less dense ($\bar{x}$ = 2.1 trees/ha) than along the river. Slopes were gentle. Most land (98%) in the units was privately-owned.

Upland units along the river were characterized as similar to the shoreline units but also contained habitat of the grand fir (Abies grandis)/queencup beadlily type. A mean of 63% of each unit was unforested; older trees averaged 23% of each unit. Upper canopy trees in each unit were of similar height ($\bar{x}$ = 22.9 m), but not as dense ($\bar{x}$ = 2.4 trees/ha) as along the shoreline of Lake Pend Oreille. Most slopes were relatively gentle. Most land (95%) was privately-owned.

BEHAVIORAL ACTIVITY BUDGETS

Time-budget data of bald eagles at areas of intense activity was recorded at five sites on 11 days during 1985-86 (110 hrs; $\bar{x}$ = 10 hrs) and at the mouth of Granite Creek during the kokanee salmon spawning run on two days in 1986-87 (14.6 hrs) (Table 13). A total of 7,780 individual activities were recorded during 1985-86 (N = 5,568) and 1986-87 (N = 2,212) from 5-min scans of eagles' behavior at the observation sites.

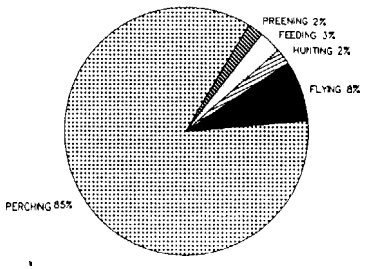
The most common bald eagle activity observed at all sites was perching during 1985-86 (85%) and 1986-87 (91%); flying, feeding, hunting, and preening were also recorded (Fig. 33). Locomotion categories were dominated by flight both years; direct flapping flight was most common, followed by soaring and gliding (Fig. 34). Live trees, followed by stumps and snags, were most often used as perch sites in 1985-86; ice which had formed in shallower bays at northern observation sites was also used. In 1986-87, live trees made up nearly all (99%) of the perch sites used by bald eagles near Granite Creek (Fig. 35).

Documentation of perch tree use on Lake Pend Oreille by bald eagles counted in the aerial censuses indicated a preference for ponderosa pine (47%) and Douglas-fir (38%). Black cottonwood (Populus trichocarpa) which are found in isolated groves and in much fewer numbers on the lake were used to a lesser extent (8%). Eagles perched most often in live trees (85%) and snags (10%) within 100 m of the shoreline (Table 14).

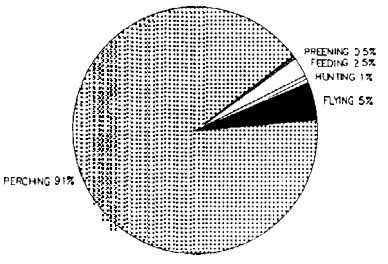
The overall capture success rate was similar between 1985-86 (85%) and 1986-87 (90%); aerial capture attempts were less productive during 1985-86 than during 1986-87 when

Table 13. Dates and sites of behavioral activity budget sessions of bald eagles, 1985-86 and 1986-87.

Date	Site	Observation session	
		Time-span	Duration (hrs)
1985-86			
10 Dec.	Bottle Bay	0650-1630	9.7
16 Dec.	Sunrise Bay	0625-1555	9.5
23 Dec.	Bottle Bay	0645-1620	9.6
30 Dec.	Sunrise Bay	0715-1615	9.0
6 Jan.	Bottle Bay	0700-1610	9.2
13 Jan.	Sunrise Bay	0700-1625	9.4
26 Jan.	Warren Island	0640-1655	10.3
4 Feb.	Bottle Bay	0645-1645	10.0
10 Feb.	Pend Oreille River	0630-1715	10.8
18 Feb.	Warren Island	0630-1730	11.0
10 Mar.	Pack River Delta	0625-1755	11.5
1986-87			
12 Dec.	Granite Creek Bay	0700-1625	9.4
28 Dec.	Granite Creek Bay	0715-1225	5.2

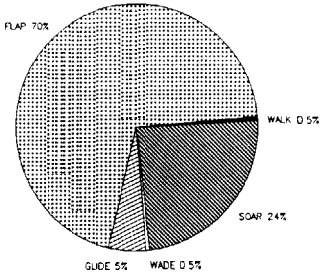


LAKE PEND OREILLE, 985-86.

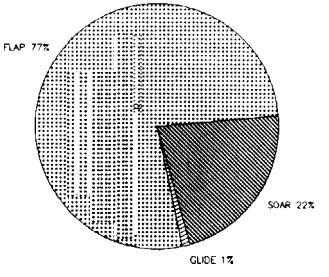


MOUTH OF GRANITE CREEK, 1986-87

Figure 33. Time budget categories of bald eagles on Lake Pend Oreille, 1985-86 and 1986-87.

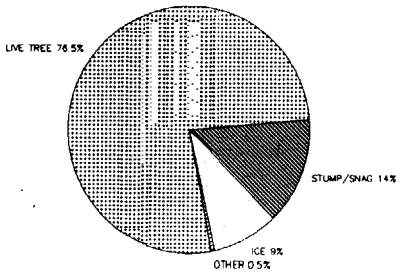


LAKE PEND OREILLE, 1985-86.

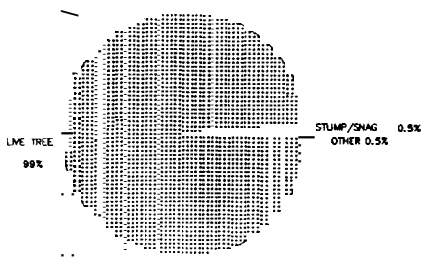


MOUTH OF GRANITE CREEK, 1986-87.

Figure 34. Time budget categories for locomotion of bald eagles on Lake Pend Oreille, 1985-86 and 1986-87.

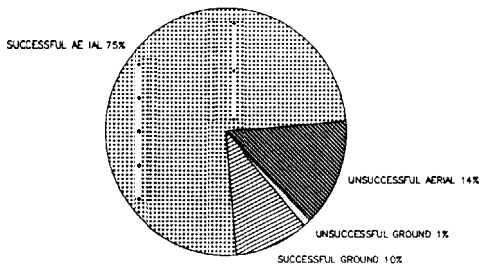


LAKE PEND OREILLE, 1985–86.

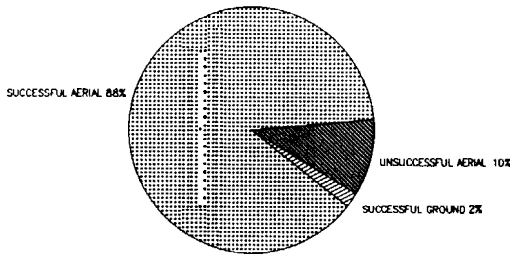


MOUTH OF GRANITE CREEK, 1986–87.

Figure 35. Perch substrates used by bald eagles on Lake Pend Oreille, 1985-86 and 1986-87.



LAKE PEND OREILLE, 1985–86.



MOUTH OF GRANITE CREEK, 1986–87.

Figure 36. Hunting success by bald eagles on Lake Pend Oreille, 1985-86 and 1986-87.

Table 14. Preference of a) species and b) structure classifications of perch trees by bald eagles in aerial censuses, 1985-86 and 1986-87.

a)

Tree species	Frequency	
	Number	Percent
Ponderosa pine	1565	47.0
Douglas-fir	1256	37.7
Black Cottonwood	249	7.5
Western redcedar	100	3.0
Western larch	87	2.6
Western white pine + Lodgepole pine	62	1.9
Grand fir + Paper birch	12	0.3

b)

Tree structure classification	Frequency	
	Number	Percent
Live tree	3962	85.4
Snag	458	9.9
Live, dead top	109	2.4
Dying tree	48	1.0
Live, broken top	36	0.8

eagles were feeding heavily on numerous salmon that were spawning near the mouth of Granite Creek (Fig. 36). After capturing prey, eagles most often perched in trees to feed during 1985-86 (69%) and 1986-87 (87%); stumps, snags, and other substrates were used to a lesser extent (Fig. 37). Preening activity was observed most often when eagles were perched in live trees (66%) and on stumps or snags (31%) in 1985-86 (Fig. 38) and exclusively in live trees in 1986-87 (100%).

FEEDING HABITS

Behavioral Activity Budgets

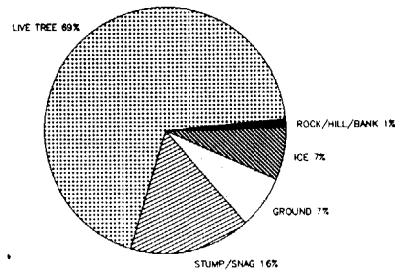
A total of 300 observations of foraging events were recorded during behavioral activity budget sessions in 1985-86 (11 days) and 1986-87 (9 days) (Table 15). Sixty-five percent of the events were by adult bald eagles (N = 192); 35% were by subadults (N = 106). Most (69%) of the foraging events resulted in the capture of prey (N = 202).

Capture attempts by adult bald eagles were more successful (71%) than attempts by subadults (60%). The mean number of capture attempts per successful outcome was 1.1. Most (78%) successful attempts by eagles were aerial, followed by captures on the ground (12%) and while standing on ice (10%) (piracy of other eagles).

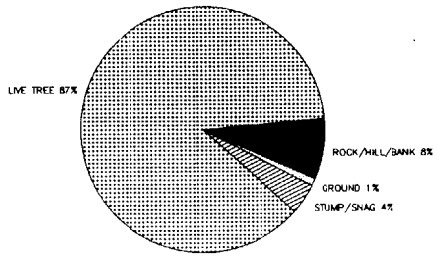
Fish species (N = 170) were the preferred prey (84%) (Fig. 39). Some prey (9%) could not be readily identified (Table 15). Capture of waterfowl by eagles during recording sessions was not observed although occasional harassment was documented.

Analysis Of Cast Pellets And Remains Of Eagle Prey

A total of 368 pellets regurgitated by eagles were collected at two major communal roosts (Bottle Bay and Warren Island) in 1985-86 (N = 200) and 1986-87 (N = 168). Analysis of the pellets for the two years combined yielded bird remains in 208 pellets, fish remains (usually scales or vertebrae) in 175 pellets, and mammal remains in 21 pellets. Contents of pellets indicated the importance of waterfowl in the diet, however, they underplayed the importance of fish because these -remains are usually digested and result in no pellet being cast (Lish and Lewis 1975, Steenhof 1976). In addition, pellets consisting primarily of fish remains often tended to break apart upon striking the ground after being cast, or, in the case of those that landed intact, disintegrated rapidly upon dessication. In contrast, waterfowl pellets held together, and often became more noticeable as they dried out.



LAKE PEND OREILLE, 1985-86.



MOUTH OF GRANITE CREEK, 1986-87.

Figure 37. Feeding substrates of bald eagles on Lake Pend Oreille, from time budget sessions, 1985-86 and 1986-87.

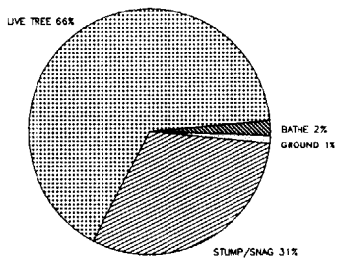


Figure 38. Preening substrates of bald eagles on Lake Pend Oreille, 1985-86.

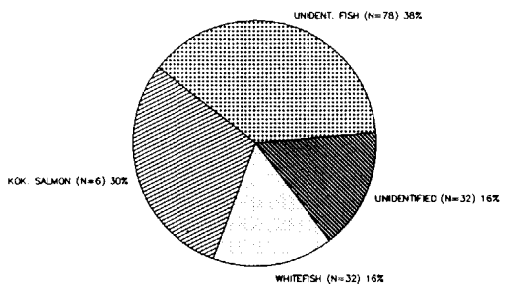


Figure 39. Prey of bald eagles during time budget sessions, 1985-86 and 1986-87.

Table 15. Observations of foraging events by bald eagles during time budget sessions, 1985-86 and 1986-87.

Site	No. days observation	No. events	Successful foraging events		Prey			
			No.	%	Unidentified fish species	Whitefish	Kokanee salmon	Unidentified other
1985-86								
Pend Oreille River	1	18	15	83	7	3	0	5
Bottle Bay	4	76	48	63	42	7	0	1
Pack River Delta	2	19	19	100	7	0	0	12
Warren Island	1	10	5	50	4	0	0	1
Sunrise Bay	3	56	34	61	11	22	0	1
Denton Slough	3	15	12	80	1	0	0	11
Lightning Creek Delta	1	20	7	35	6	0	1	1
1986-87								
Granite Creek	4	68	62	91	0	0	59	0

Bird remains were found in pellets less often in 1985-86 (N = 95) than in 1986-87 (N = 113); American coots (Fulica americana) were the most common bird remains identified (Table 16). Remains of fish were found more often in 1985-86 (N = 118) than in 1986-87 (N = 57); Lake Superior whitefish and kokanee salmon (in 1986-87) were the most common fish species, however, many fish remains could not be classified with certainty to species. Mammal remains were identified in pellets less often in 1985-86 (N = 7) than in 1986-87 (N = 17); whitetail deer remains were most common, particularly in 1986-87. Lower numbers of bird remains in 1985-86 pellets when harsher weather conditions on the lake persisted and resulted in birds' earlier departure south, and higher numbers of available whitefish in the lake which died from spawning stress (Horner, personal communication, 1987), support the view of the bald eagle as an opportunistic raptor which utilizes the most abundant and accessible prey.

Collection of prey remains at feeding sites of bald eagles yielded additional prey species not identified in pellets. These included one bird species (Canada goose [Branta canadensis]) and four fish species (largemouth bass, largescale sucker, northern squawfish, pumpkinseed [Lepomis sibbosus]).

SALMON CARCASS AVAILABILITY FROM CABINET GORGE HATCHERY

A total of 4,214 tagged kokanee salmon carcasses were released into the Clark Fork River adjacent to the Cabinet Gorge Hatchery on 7, 21, and 25 November 1986 (Table 17). Almost all carcasses dropped rapidly toward the riverbottom after release: many of those released near shore were seen lying on the bottom where observed progress downstream was minimal. A total of ten tags were located during 11 surveys: nine tags (of 1000 pink tags) had been released in mid-channel on 7 November: one tag (of 214 green tags) had been released near the shore on 21 November.

Two of the recovered tags were found along the south side of the river at RM 149 within 100 m downstream of the release site: the green tag and carcass with 60% of the flesh remaining were found 3 m above high water mark; one pink tag was located 10 m above high water mark under a western redcedar perch tree. Eight tags (all pink) were located in the vicinity of a gravel island which divides the river along RM 147 approximately 3 km below the release site: three carcasses were found lying stationary in water about 1 m deep along the north side of the island; two carcasses were observed rolling with the current along the bottom of the river on the north side of the island; one tag

Table 16. Frequency of occurrence of prey species in 368 cast pellets of bald eagles at Lake Pend Oreille, 1985-86 (N = 200) and 1986-87 (N = 168).

Category and species	1985-86	1986-87	Total
Birds			
American coot (Fulica americana)	35	53	88
Mallard (Anas platvrhvnchos)	9	19	28
Redhead (Avthva americana)	17	8	25
Lesser scaup (Avthva affinis)	9	11	20
Green-winged teal (Anas crecca)	0	4	4
Common merganser (Mersus merganser)	3	1	4
Bufflehead (Bucephala albeola)	1	1	2
Common goldeneye (Bucephala clansula)	1	0	1
Ring-necked duck (Avthva collaris)	1	0	1
Unidentified	19	17	36
Fish			
Lake Superior whitefish (Coregonus clupeaformis)	8	14	22
Kokanee salmon (Onchorhvnchus nerka)	1	13	14
Kamloops rainbow trout (Salmo sairdneri)	2	0	2
Mountain whitefish (Prosopium williamsoni)	1	0	1
Perch (Perca flavescens)	0	1	1
Unidentified	106	29	135
Mammals			
White-tailed deer (Odocoileus virsinianus)	2	14	16
Deer mouse (Peromvscus maniculatus)	1	1	2
Red squirrel (Tamiasciurus hudsonicus)	1	1	2
Muskrat (Ondatra zibethicus)	0	1	1
Unidentified	3	0	3

Table 17. Releases and surveys of tagged kokanee salmon carcasses on the lower Clark Fork River, 1986.

Release		Released Tags		Survey			Recovered tags	
Date	Location	#	Color	Date	Time	Distance	#	Color
7 Nov.	10 m offshore	1000	white	7 Nov.	PM	16 km	0	-
	Mid-channel	1000	pink					
				8 Nov.	AM	16 km	0	-
				9 Nov.	AM	16 km	0	-
21 Nov.	10 m offshore	1000	white/ black	21 Nov.	PM	14 km	3	pink
	10 m offshore	214	green					
				22 Nov.	AM	14 km	1	pink
				22 Nov.	PM	14 km	0	-
				23 Nov.	AM	14 km	1	green
							2	pink
25 Nov.	10 m offshore	480	orange/ black	25 Nov.	PM	14 km	3	pink
	10 m offshore	480	white/ blue					
				26 Nov.	AM	14 km	0	-
				30 Nov.	AM	14 km	0	-
				3 Dec.	AM	14 km	0	-

and jaw of the fish were found about 15 m from the river under a black cottonwood perch tree; two tags were found under a black cottonwood perch tree along the north shore of the river about 3 m above high water mark, apparently discarded there by eagles eating the carcasses from the tree above.

Insufficient numbers of tags were recovered to make statistically valid conclusions about salmon carcass stranding and availability to bald eagles. However, the tags that were recovered appear to indicate that mid-channel releases would be more effective in allowing carcasses to drift downstream to shallower water where they would become more accessible to eagles. Although carcasses did not move downstream readily after release from near the shoreline, the single green-tagged carcass recovered that was marked and released the same morning at the hatchery may indicate more fish will float near the surface in immediate releases of artificially-spawned salmon from the hatchery. More fish could be made available to bald eagles and other predators if future releases were conducted at a site as far out into the current as possible with freshly-killed or anaesthetized fish that have their air bladders intact to allow a higher floatation rate.

SUMMARY

Lake Pend Oreille, the lower Clark Fork River, and the upper Pend Oreille River are important areas for large numbers of wintering bald eagles. The relative lack of human disturbance to eagles throughout most of the area, the large area that eagles have to escape disturbance, and the numerous diurnal perches from which eagles may hunt and feed, all add to the present and future importance of the area to bald eagles. The abundance and variety of eagle prey found there contribute to the significance of this location where many eagles may remain until they begin migrating north in the spring. The enhancement of the kokanee salmon fishery in Lake Pend Oreille through the operation of the Cabinet Gorge Hatchery should contribute toward providing eagles with a plentiful food source during the autumn months. Other fish species found in the lake and rivers, particularly whitefish, and waterfowl especially during milder winters, will continue to provide eagles with alternate sources of prey. As a result of the continued loss of eagle habitat nationwide and the unpredictability of food sources such as spawning runs of fish and concentrations of migrating waterfowl, with proper management the potential is high for the Lake Pend Oreille area to continue to play a major role for wintering bald eagles in the region.

The following are recommendations for the management of the Lake Pend Oreille bald eagle concentration and important eagle habitat.

1. Aerial censuses of bald eagles on Lake Pend Oreille, the lower Clark Fork River, and the upper Pend Oreille River should be continued so that a record of eagle abundance and distribution can be maintained. The annual National Wildlife Federation bald eagle count of the area by itself is insufficient for making knowledgable management decisions. Censuses will also provide the opportunity to search for the return of wing-marked eagles from Lake Pend Oreille and for the arrival of those from Glacier National Park.

2. It will be several years before the enhancement of the kokanee 'salmon fishery on the lake by the operation of the Cabinet Gorge Hatchery will be realized. Once this has occurred, however, additional study will be required to assess the effects to bald eagles of the increase in food availability. Information on eagle numbers, distribution, food habits, and local movements, and availability of prey species will be necessary to make comparisons with past use of the area by bald eagles.

3. **Bald eagle roosts should be protected from human disturbance, and harvest of roost trees should be avoided in order to maintain quality bald eagle habitat. Private individuals having roosts on their property should be approached regarding management of these sites. Specific management plans should be developed for all eagle roosts.**

4. **Perch trees, especially those located where eagles concentrate, should be protected. These sites are preferred as a result of the structure of the trees, protection from disturbance, and the availability of prey in the area.**

5. **Bald eagle nesting sites should be protected, productivity surveys continued, and the size of nesting territories determined. Searches for alternate and new nest sites should be continued. Site-specific management plans should be developed for each nesting territory.**

6. **The presence of such large numbers of wintering bald eagles in northern Idaho is impressive and worthy of note by the media. Efforts to increase public awareness and appreciation of the bald eagle concentration on Lake Pend Oreille should be continued.**

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APPENDICES

APPENDIX A

FIELD DATA FORMS AND EAGLE BEHAVIOR CODES

APPENDIX A-1

BALD EAGLE CENSUS DATA SHEET

DATE:_____

OBSERVERS:_____

PILOT:_____ AIRCRAFT TYPE:_____

WEATHER AT START: CLOUD COVER:_____ 1 = 0-25% 3 = 51-75%
2 = 26-50% 4 = 76-100%

: PRECIPITATION:_____ 0 = None 2 = Heavy rain
1 = Light rain 3 = Snow

: WIND VELOCITY:_____ 0 = Calm 3 = 11-15 mph
1 = 1-5 mph 4 = 16-25 mph
2 = 6-10 mph 5 = 26-∝ mph

: WIND DIRECTION (°):_____

TIME: START_____ BREAKS: START_____; START_____

: FINISH_____ : FINISH_____; FINISH_____

FLIGHT PATH_____

_____

COMMENTS:_____

_____

_____

OF MARKED EAGLES:_____

AGE CLASS OR CODE:_____ LOCATION:_____

:_____ :_____

:_____ :_____

TRANSMITTER-EQUIPPED EAGLES: FREQUENCY:_____ LOCATION:_____

COMMENTS:_____ :_____ :_____

:_____ :_____ :_____

:_____ :_____ :_____

:_____ :_____ :_____

COUNT TOTALS	#ADULTS	#SUBADULTS	#UNKNOWN	TOTAL
NOXON RESERVOIR (DAM UPSTREAM TO _____)				
CABINET GORGE RESERVOIR				
LOWER CLARK FORK RIVER				
LAKE PEND OREILLE				
PEND OREILLE RIVER: TO MUSKRAT LAKE				
: MUSKRAT LAKE TO ALBENI FALLS DAM				
TOTAL: FOR STUDY AREA				
TOTAL: ALL COUNTS				

APPENDIX A-2

BALD EAGLE MARKING AND BANDING DATA SHEET

DATE _____

MARKER # _____ BAND # _____ LEG _____

RADIO-TRANSMITTER # _____ FREQUENCY _____

BANDER *NAME* _____

RECORDER NAMB _____

TIME OF CAPTURE _____

TRAPSITE LOCATION _____

TRAP TYPE _____

BAIT TYPE _____

HOW CAPTURED (Toe, Tarsus, **etc.)** _____

MEASUREMENTS	LEFT	RIGHT
HALLUX TALON LENGTH:	_____mm.	_____mm.
FOOT PAD LENGTH:	_____	_____
NARROWEST TARSAL WIDTH FRONTAL:	_____	_____
WING CHORD:	_____cm.	_____cm.
TAIL LENGTH:	_____cm.	
CULMEN DEPTH:	_____mm.	
CULMEN LENGTH:	_____	
WEIGHT:	_____kg.	_____lbs.
CROP CONDITION:	_____	
STERNUM CONDITION:	- 1 2 3 4 5 +	
WINGSPAN:	M_____cm	_____in.
ESTIMATED AGE:	_____	
SEX (Method of Determination)	M F	_____

BEHAVIOR

IN TRAP (Active, Aggressive, Docile. etc.) _____

WHILE RESTRAINED _____

HOODED? _____ WET? _____ ICE ON FEATHERS? _____

TYPE OF RELEASE _____ TIME _____

FLIGHT PATH AND BEHAVIOR _____

_____

_____

COMMENTS _____

_____

APPENDIX A-3

TRANSMITTER-EQUIPPED EAGLE LOCATION DATA SHEET

DATE: _____ OBSERVERS: _____

TIME: START: _____ FINISH: _____

SURVEY TYPE: _____ AERIAL _____ DAY _____ NIGHT ROOST _____ ROOST COUNT

WEATHER: CLOUD COVER: _____ 1 = 0-25% 2 = 26-50% 3 = 51-75% 4 = 76-100%

PRECIPITATION: _____ 0 = None 1 = Light rain 2 = Heavy rain 3 = Snow

WIND VELOCITY: _____ 0 = Calm 1 = l-5 mph 2 = 6-10 mph 3 = 11-15 mph 4 = 16-25 mph 5 = 26- mph

WIND DIRECTION (°): _____

MARKER #: _____ TRANSMITTER FREQUENCY: _____

LOCATION TYPE: _____ VISUAL _____ TRIANGULATION

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

LOCATION: _____

_____

REMARKS: _____

_____

MARKER #: _____ TRANSMITTER FREQUENCY: _____

LOCATION TYPE: _____ VISUAL _____ TRIANGULATION

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

TIME: _____ SITE: _____ DEGREE: _____

LOCATION: _____

_____

REMARKS: _____

_____

APPENDIX A-4

CODES FOR BEHAVIORAL ACTIVITIES OF BALD EAGLES

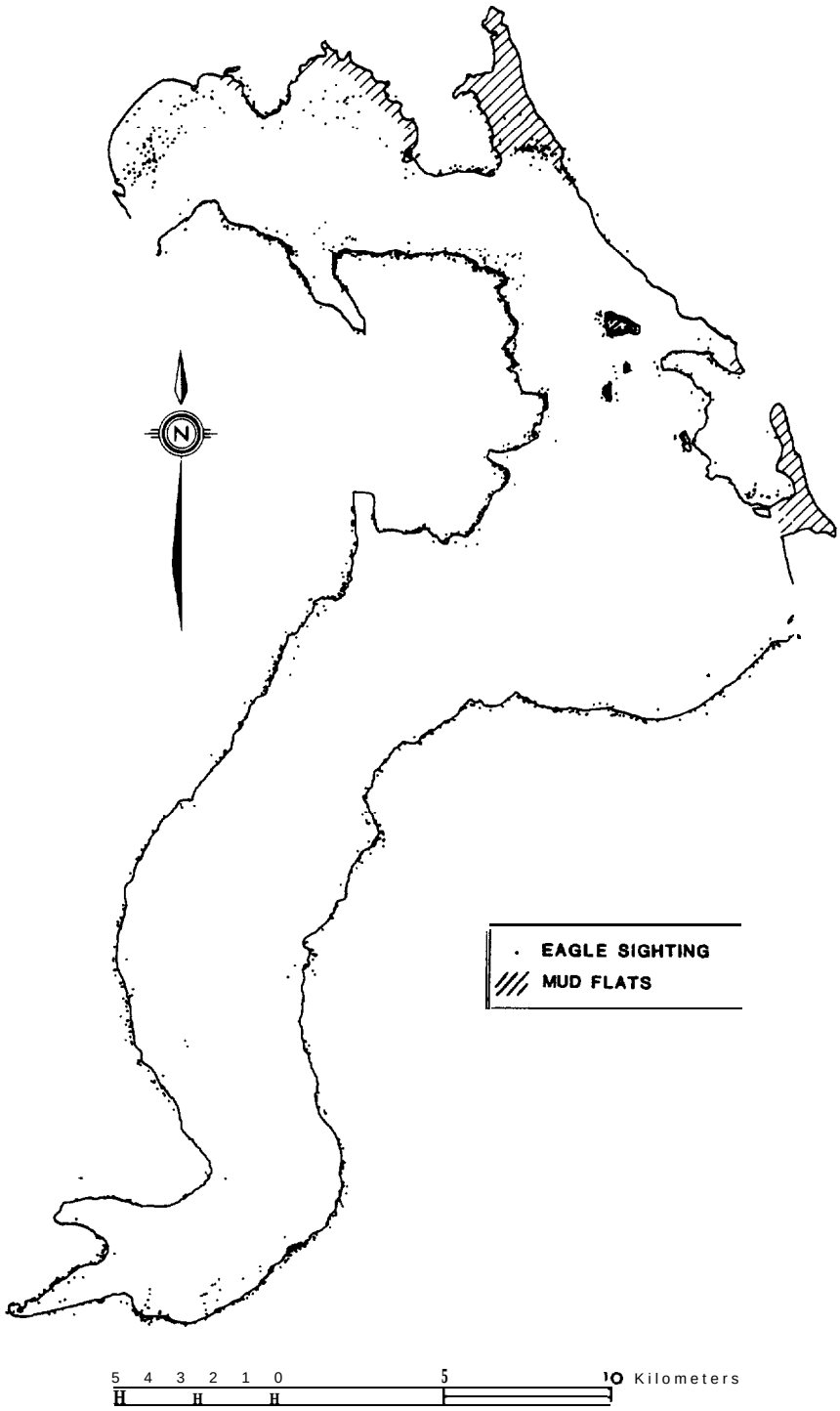
Code	Activity
01	Adult bald eagle
02	Subadult bald eagle
03	Unknown age class
10	Soar
11	Glide
12	Flap-fly
13	Flap-fly with fish
14	Flap-fly with other
20	Perch, rock/hill/bank
21	Perch, stump/snag
22	Perch, tree
23	Perch, wing-droop, rock/hill/bank
24	Perch, wing-droop, stump/snag
25	Perch, wing-droop, tree
26	Preen, rock/hill/bank
27	Preen, stump/snag
28	Preen, tree
29	Preen, ground
30	Stand, ground
31	Stand, ground with fish
32	Stand, water
33	Stand, water with fish
34	Drag fish out of water
35	Stand, ice
36	Stand, ice with fish
40	Walk
41	Wade
42'	Bathe
43	Swim
50	Consume fish, water
51	Consume fish, ground
52	Consume fish, rock/hill/bank
53	Consume fish, stump/snag
54	Consume fish, tree
55	Consume fish, ice
56	Consume other
57	Bill-clean

Code	Activity
60	Aerial capture, successful
61	Aerial capture, unsuccessful
62	Aerial capture, pirate
63	Aerial capture, pirated
64	Aerial capture, piracy attempt
70	Ground capture, successful
71	Ground capture, unsuccessful
72	Ground capture, pirate
73	Ground capture, pirated
74	Ground capture, piracy attempt
75	Capture, unknown method
80	Drop prey, perch, unforced
81	Drop prey, perch, forced

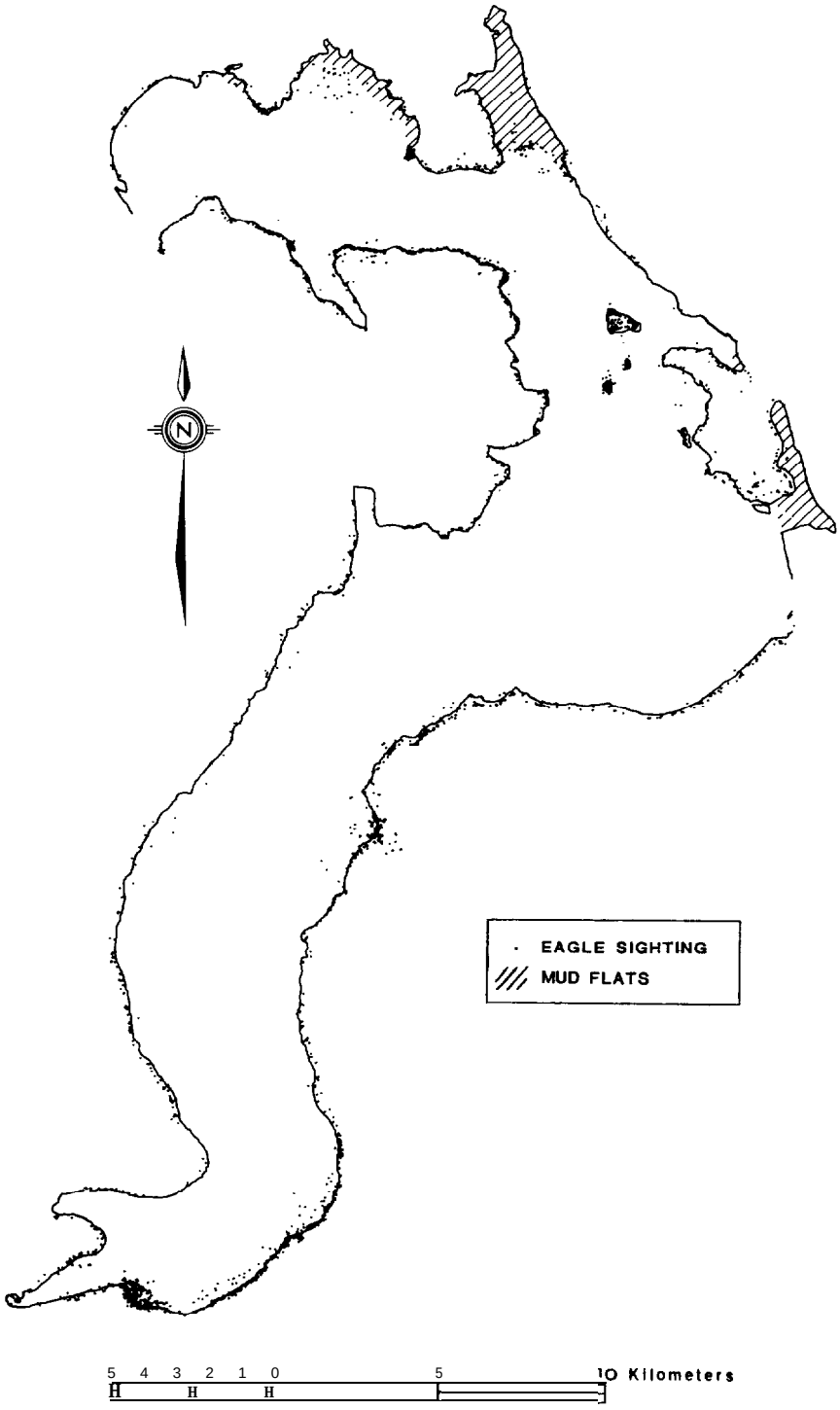
APPENDIX B

LOCATIONS OF BALD EAGLES IN WEEKLY AERIAL CENSUSES OF LAKE PEND OREILLE, 1985-86 AND 1986-87

APPENDIX B-l
LOCATIONS OF BALD EAGLES IN WEEKLY AERIAL CENSUSES
OF LAKE PEND OREILLE, 1985-86 (N = 19 CENSUSES)



APPENDIX B-2
LOCATIONS OF BALD EAGLES IN WEEKLY AERIAL CENSUSES
OF LAKE PEND OREILLE, 1986-87 (N = 23 CENSUSES)



APPENDIX C

BIOLOGICAL DATA ON CAPTURED BALD EAGLES ON LAKE PEND OREILLE, 1986.

Marker #	Age (yrs)	Hallux length (mm)		Foot pad length (mm)		Tarsus width (mm)	
		Left	Right	Left	Right	Left	Right
01	6+	42.2	42.8	115.0	95.0	17.4	17.7
02	6+	41.6	42.5	99.0	105.0	19.5	18.6
03	6+	39.9	39.4	98.0	99.0	18.7	17.8
04	6+	41.8	41.9	102.0	100.0	17.6	16.7
05	6+	40.7	40.4	97.0	96.0	18.6	17.9
06	4-5	39.9	39.1	96.0	96.0	17.1	17.0
07	6+	39.2	39.3	102.0	98.0	17.7	18.0
08	4-5	45.4	44.4	110.0	112.0	18.4	17.8

Marker #	Culmen depth (mm)	Weight (kg)	Wingspan (cm)	Wing chord (cm)		Tail length (cm)	Crop condition
				Left	Right		
01	33.0	4.90	197.0	56.3	56.2	27.4	empty
02	36.0	5.25	205.0	58.1	58.1	28.2	empty
03	33.0	4.60	190.0	55.3	57.2	27.6	full*
04	33.2	3.60	199.0	54.7	54.8	26.3	empty
05	33.7	4.70	196.0	58.4	57.7	26.6	empty
06	33.4	3.80	196.0	56.7	56.4	27.9	empty
07	33.2	5.30	196.0	53.5	54.8	25.1	empty
08	36.8	5.50	192.0	59.9	60.3	31.5	empty

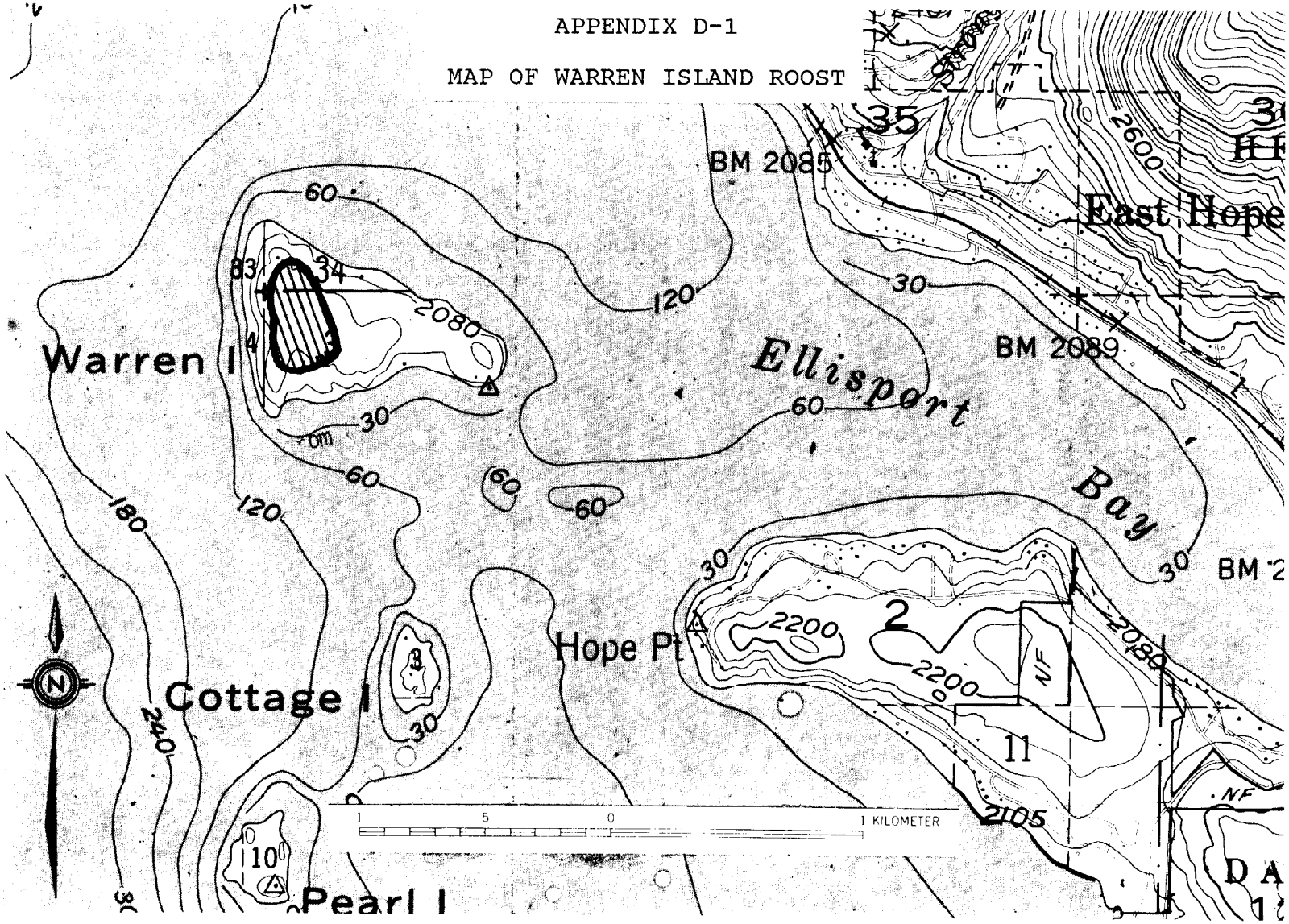
*Eagle ate first capture fish; was captured on second fish soon after.

APPENDIX D

MAPS OF BALD EAGLE COMMUNAL ROOSTS ON LAKE PEND OREILLE, 1985-86 AND 1986-87

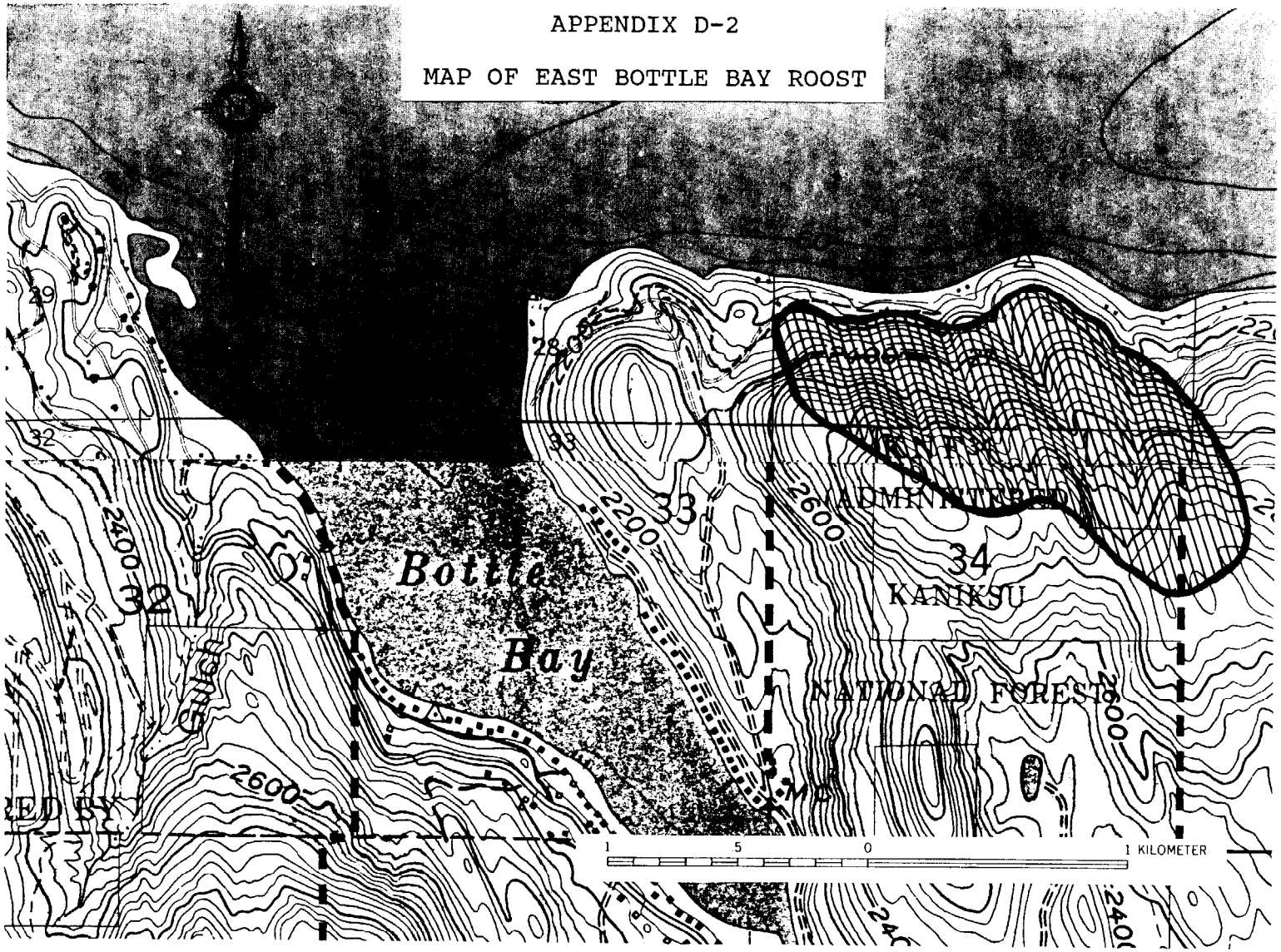
APPENDIX D-1

MAP OF WARREN ISLAND ROOST



APPENDIX D-2

MAP OF EAST BOTTLE BAY ROOST



APPENDIX D-3

MAP OF ECHO BAY ROOST